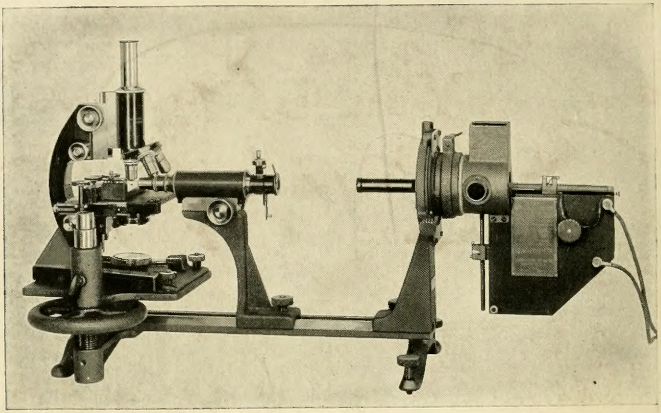

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THE COLLECTING NET

Vol. XII, No. 1 SATURDAY, JULY 3, 1937 Annual Subscription, $2.00 Single Copies, 30 Cents.

EXPERIMENTAL ANALYSIS OF EARLY STAGES IN TELEOST DEVELOPMENT

Dr. Jane Oppenheimer, *Yale University*

Students of teleostean development who merely watch the normal developing embryo have a delightful opportunity of watching the processes whereby the egg molds itself into an embryo. Such investigators, however, can see only the accomplishment of the whole egg, and the behaviour of its constituent parts cannot be analyzed by observation alone. In order to elucidate the precise role of small groups of cells, which ultimately will form particular tissues and organs and to elucidate some of the causes for their differentiation, new techniques have been devised to supplement the old.

There are principally two such techniques. In the first, specified groups of cells are marked by the local application of vital stain so that their subsequent behaviour may be observed. The application of this method, originally introduced by Vogt for the study of amphibian development, has enabled investigators to study in early stages the precise location of cells normally destined to form specific tissues or organs, and to study the move-

(*Continued on page 5*)

THE BIOLOGICAL LABORATORY, COLD SPRING HARBOR

Dr. Eric Ponder, *Director*

The summer activities of The Biological Laboratory of the Long Island Biological Association at Cold Spring Harbor will open on June 21st with the first meetings of the course in Surgical Methods in Experimental Biology and of the course in Experimental Endocrinology, and with the first meetings of the fifth of the Cold Spring Harbor Symposia on Quantitative Biology.

The course in Surgical Methods is again being given by Dr. George W. Corner of the University of Rochester. Each year this course is attracting more graduate students and young investigators who wish to obtain a knowledge of special surgical techniques. The course in Experimental Endocrinology, which is also fully registered, is being given by Dr. H. O. Haterius of Ohio State University and Dr. Robert Gaunt of New York University. The plan is to have these two courses work together so that lectures are held in common and the students in the endocrinology course work to some extent on animals prepared in the course in surgical meth-

M. B. L. Calendar

TUESDAY, July 6, 8:00 P. M.

Seminar: Dr. Ethel Browne Harvey: "Parthenogenetic Merogomy in the Naples Sea Urchin."

Dr. Jean Brachet: "Some Oxidative Properties of Isolated Amphibian Germinal Vesicles."

Dr. Albert Tyler: "Influence of Temperature and Other Agents on the Respiration and Development of Marine Eggs."

FRIDAY, July 9, 8:00 P. M.

Lecture: Professor E. Newton Harvey: "Electrical Potentials from the Human Brain."

First Evening Lecture presented by Dr. Astbury.

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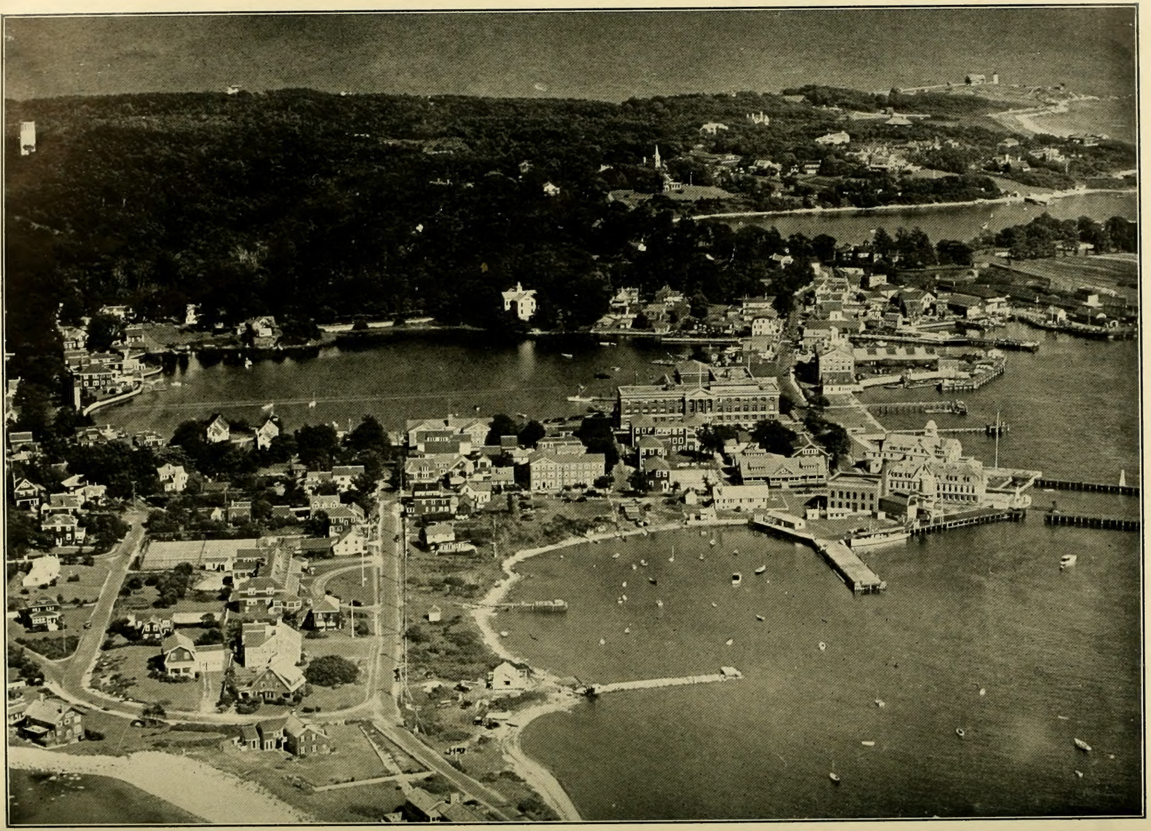

THE MARINE BIOLOGICAL LABORATORIES OF WOODS HOLE ods. In order to accommodate the large number of animals which are required, a new animal room has been built in the Davenport Laboratory, which has also been remodeled to meet the needs of the two courses.

The Symposium subject this year is that of Internal Secretions, with particular emphasis on bio-assay and hormone chemistry. The program falls into three sections: pituitary and gonad hormone chemistry, pituitary-gonad relations, and hormones and metabolism.

Program

I. PITUITARY AND GONAD HORMONE CHEMISTRY

Tuesday, June 22

James C. Munch: Fundamental principles of endocrine bioassays.
Robert W. Bates: Methods for the assay of prolactin.

Wednesday, June 23

H. L. Fevold: The gonadotropic hormones.
W. R. Lyons: Preparation and assay of mammotropin.

Thursday, June 24

G. F. Marrian: The natural conjugated estrogens.
Oskar Wintersteiner: New estrogens from the urine of pregnant mares.

Friday, June 25

F. C. Koch: Recent advances in the field of androgens.
Roy O. Greep: Hypophyseal regulation of the male gonad.

Saturday, June 26

Robert C. Elderfield: The chemistry of some physiologically important natural substances related to phenanthrene.

II. PITUITARY-GONAD RELATIONS

Monday, June 28

Carl Moore: Testis hormone secretion and some effects of the hormone in the organism.
Warren O. Nelson: Some factors concerning the gametogenic and endocrine functions of the testis.

Tuesday, June 29

Gregory Pincus: The metabolism of ovarian hormones, especially in relation to the growth of the fertilized egg.
J. B. Collip: Properties of anterior lobe extracts.

Wednesday, June 30

Edgar Allen: Animal reactions to estrogens.
E. T. Engle: Endometrium response to hormones.

Thursday, July 1

Samuel R. M. Reynolds: Hormonic and physical factors in uterine growth.
Curt P. Richter: Hypophyseal control of behavior.

Friday, July 2

Oscar Riddle: Physiological responses to prolactin.
George W. Corner: The rate of secretion of progestin by the corpus luteum.

Saturday, July 3

J. A. Morrell: The biological assay of estrogenic substances.

Tuesday, July 6

Harry A. Charipper: Pituitary cytology in amphibians and fishes.
J. P. Schooley: Pituitary cytology in pigeons.

Wednesday, July 7

J. A. Morrell: The biological assay of pregnancy urine extracts.
Herbert M. Evans: The gonadotropic complex.

Thursday, July 8

Willard Allen: Some effects of estrin and progestin in the rabbit.
L. V. Domm: Observations concerning anterior pituitary-gonadal interrelations in the fowl.

Friday, July 9

Joseph C. Hinsey: The relation of the nervous system to ovulation and other phenomena of the female reproductive tract.
Emil Witschi: Comparative physiology of the anterior lobe of the vertebrates.

Saturday, July 10

H. O. Haterius: Studies on a neuro-hypophyseal mechanism regulating gonadotropic principles.

III. HORMONES AND METABOLISM

Monday, July 12

Frank A. Hartman: Hormones of the adrenal cortex.
E. C. Kendall: A chemical and physiological investigation of the adrenal cortex.

Tuesday, July 13

Arthur Grollman: The physiology and chemistry of the adrenal cortical hormone.
Robert Gaunt: Certain aspects of pituitary-adrenal relationships.

Wednesday, July 14

A. C. Ivy: Enterogastrone.
C. P. Rhoads: Hemolysis in clinical and experimental anemia.

Thursday, July 15

W. B. Castle: Relationship of gastrointestinal dysfunction to anemia.
R. L. Zwemer: Electrolyte and sugar determinations as indicators of adrenal influence on normal cell activity.

Friday, July 16

A. S. Gordon: The reticulo-endothelial system and the concept of antihormones.

Saturday, July 17

A. E. Severinghaus: Some aspects of anterior lobe function, suggested by a cytological study of experimentally altered glands.

Monday, July 19

W. W. Swingle: Experimental studies on the function of the adrenal cortex.

Tuesday, July 20

C. N. H. Long: Studies on the diabetogenic action of the anterior pituitary.
S. W. Britton: Adrenal cortex and carbohydrate metabolism.

Wednesday, July 21

Oscar Riddle: Pituitary and carbohydrate metabolism.

Thursday, July 22

G. A. Harrop: The influence of the adrenal cortical hormones and related compounds upon the electrolyte and water balance.

Friday, July 23

W. R. Ingram: Relations of the hypophysis and associated hypothalamic mechanisms to water exchange.

Those taking part in the Symposium will all be in residence at the Laboratory at one time or another, and most of them for a considerable period. The papers will later be published as Volume V of the Cold Spring Harbor Symposia on Quantitative Biology.

There seems to be no doubt as to the value of these Symposia, for they have the advantage of proceeding in a leisurely manner, so that the participants get time to discuss their problems in a way which is impossible at an ordinary scientific meeting. Thus we have 45 papers this year, but they are given over a period of five weeks, one each morning and one each afternoon. Contrast this with a recent meeting of an endocrinology group in which 45 papers were scheduled to be given in two days, or another meeting of a group of general physiologists in which 53 papers were scheduled to be given in the same time. What happened in both cases, of course, was that fully half the papers were never read at all, and the discussion of those which were read had to be restricted to five minutes. The policy of the Laboratory is therefore to keep the Symposia small and to restrict participation to those who are admitted experts in their field. This is something which is becoming increasingly difficult to do because of the popularity which always attends success. The fact that the Symposium for this year is so extensive is that the field is one in which there are a very large number of investigators, and the increase in size does not in any sense represent a trend in the direction of expansion. The only way in which the Symposia might be made to grow is by encouraging collaboration in research work among the participants. It happens every year that the discussions give rise to problems which can be worked upon from different angles by members of the group, and although such problems can rarely be solved during a single summer, the main lines of attack can be decided on and preliminary results obtained before the investigators have to separate to go to their respective universities. One of the principal reasons for the existence of the Laboratory is to act as a coordinating mechanism; it was with this idea in mind that the Symposia were started, and an obvious extension of the same idea is to give the investigators who are invited to take part in the Symposia an opportunity to work with each other in the laboratory. We hope to be able to make this plan a reality in future years.

It is very gratifying to be able to report that the Rockefeller Foundation has increased its support of the Symposia, and has made a grant of $10,000 for 1938 and the same sum for 1939.

During the second half of the summer the Laboratory is offering courses in Marine and Fresh Water Zoology, given by Dr. Herman T. Spieth of the College of the City of New York and Dr. W. A. Castle of Brown University, and in Plant Sociology, given by Dr. Stanley A. Cain of the University of Tennessee. Cold Spring Harbor and its vicinity is remarkably well suited for field work both in zoology and in botany, and it is gratifying to find that the registration in these courses is much greater than it has been in the past.

The research work which is in progress is partially a continuation and extension of the all-year-round work in biophysics and physiology, and partly work planned by visiting investigators. Dr. Fricke, who is to be assisted by Dr. A. Parts, an investigator from Esthonia, is continuing his investigations on membranes and surface conductance, and also his investigations on the chemical effects of x-rays. Dr. S. R. M. Reynolds will be working with Mr. MacLeod on metabolic gradients in the uterus under estrogen. Dr. D. R. Climenko and Dr. Ellis J. Robinson, who has just joined his permanent staff, are working in collaboration with Mr. J. C. Abels on toxic effects of the benzene derivatives, and Mr. Abels is synthesizing simple hemolytic glucosides and taking part in an investigation of intravascular hemolysis with Dr. E. Ponder. Dr. Abramson and Dr. Moyer, holding the John D. Jones Scholarship, assisted by Mr. Sookne and Mr. Ochs, are continuing their work on the electrophoretic properties of protein surfaces, and are developing a new method for the estimation of histamine in blood; with Mr. Abels, Dr. Moyer is undertaking an investigation on the characteristics of the protein in nephrosis. Drs. Haterius, Gaunt, Nelson, Donahue and Cunningham are working on various aspects of endocrinology, and Mr. Charles Lloyd, holding the Temple Prime Scholarship, is carrying out an investigation under the direction of Dr. Corner. The arrival of other investigators will be reported from time to time in the Cold Spring Harbor News Notes in The Collecting Net.

THE COLLECTING NET has been entered as second-class matter July 11, 1935, at the Post Office at Woods Hole, Massachusetts, under the Act of March 3, 1879. It is devoted to the scientific work at marine biological laboratories. It is published weekly for ten weeks between June 1 and September 15 from Woods Hole and printed at The Darwin Press, New Bedford. Its editorial offices are situated on the third floor of the Woods Hole station of the United States Bureau of Fisheries. Between June 1 and October 1 communications should be addressed to Woods Hole, Massachusetts; at other times they should be directed to THE COLLECTING NET, Garrison, N. Y. Single copies cost 30c; a subscription (containing not less than 280 pages) costs $2.00.

EXPERIMENTAL ANALYSIS OF EARLY STAGES IN TELEOST DEVELOPMENT

(Continued from page 1)

ments whereby these cells attain their final position.

Once the normal behaviour of groups of cells is known, some of the underlying factors determining the behaviour may be analyzed by isolating groups of cells from their original positions and either allowing them to differentiate in suitable media or grafting them to strange positions in other eggs, in other words, by changing their relationships with other cells of the egg.

These methods have been applied to the teleostean eggs by Dr. Luther, Dr. Pasteels and myself, and it is the results of these experiments which I shall report today.

Vital staining experiments have been performed on trout eggs by Pasteels and on Fundulus eggs by myself. The work on Fundulus has consisted of a double series of experiments, tracing cells firstly from the gastrula into the formed embryo and secondly from the cleaving blastoderm to the gastrula.

When the posterior lip of the early shield of a Fundulus gastrula is stained, for instance, the stain subsequently becomes localized in the endoderm. This area is therefore considered the "presumptive endoderm." The position of the presumptive notochord in Fundulus has not been accurately analyzed by the method of vital staining, but, judging by analogy with other forms and from the results of other experiments, the presumptive notochord lies in a crescent immediately anterior to the crescent of presumptive endoderm.

The presumptive nervous system is located in the center of the shield. When the center of the shield is stained with Nile blue sulphate, the color is localized in practically the whole nervous system. This material for the nervous system is stretched out antero-posteriorly as the embryonic shield grows; a few cells at either side converge towards the midline as this occurs. In addition, the vital staining experiments show that the material for forebrain and optic vesicles is not located in the shield at the beginning of gastrulation, but it migrates into the shield anteriorly without ever approaching the dorsal lip during the period of gastrulation.

The presumptive mesoderm for the head is provided by the lateral wings of the early shield, which invaginate typically. The mesoderm for the somites is provided by the germ-ring, as demonstrated originally in 1895 by Kopsch and Morgan. The cells of the germ-ring 180° removed from the embryonic shield join the embrvo as the blastopore closes to aid in the formation of tailbud blastema.

This scheme is strikingly similar to that of the trout as worked out by Pasteels, and differs from it only in the shape of the area for nervous system. In the Trout, as in the amphibian, this is a wide crescent, not a solid block as in Fundulus. Dr. V. Hamburger has suggested that the differences between the plans for Trout and Fundulus may be based on the fact that the stages mapped are not strictly comparable, and it is highly probable that this is the case.

In Fundulus, the map of the presumptive organ-forming areas has been traced back even to the cleaving blastoderm. The four end-cells of the sixteen-cell stage may form the early embryonic shield; the fifth cleavage plane divides these roughly into presumptive notochord and endoderm peripherally, and presumptive nervous system and mesoderm centrally. The sixth cleavage plane again roughly separates the two latter areas from each other. In the rest of the blastoderm, the peripheral ring of cells of the thirty-two-cell stage forms germ-ring. Two of the central cells of the sixteen-cell stage give contributions to the embryo in the form of the cells for the forebrain and eye, and for the head-mesoderm.

This plan is not a rigid one. It holds only when the second cleavage plane of the blastoderm coincides with the embryonic axis and this, though frequent, is not an invariable occurrence. Sometimes the embryonic axis is oblique with reference to all of the early cleavage planes, and in such a case there can be no "mosaic" differentiation.

The regulability of teleostean development is further shown by the fact that a single blastomere of the two-cell stage can form a whole embryo, as demonstrated by Morgan, Lewis and Hoadley.

The process which allows the development of a whole embryo by a cell which might normally form only a half has been worked out, and is explained by the fact that important developmental factors which govern differentiation come into play at gastrulation. In Fundulus, when the dorsal lip of the blastopore, the posterior lip of the embryonic shield, is transplanted to an indifferent region of another gastrula, it induces in that region the formation of a new embryo. For this reason, the dorsal lip of the blastopore is called the "organizer" of the egg. This was first worked out for the amphibian egg by Professor Spemann, and has been demonstrated in Fundulus by me and in the trout by Luther.

The manner of action of the organizer has been analyzed in various ways. It has been demonstrated that its action must be of a fairly generalized chemical type, since organizers of one species of embryo can cause inductions in eggs of species far removed. Furthermore dead organizers and dead tissues of manifold sorts do the same thing. Furthermore, the mechanism of induction during gastrulation is well-known; the invaginated notochord and mesoderm cause the cells above them to differentiate nervous system. This has been amply demonstrated by grafting strange tissues over mesoderm and studying their differentiation, or by grafting the substrate tissues and following the differentiation of the affected cells.

These results have demonstrated conclusively that development in the forms with which we are concerned consists of a series of interdependent processes, each one initiated by a process occurring immediately previous. The interrelationships of many of these processes have been worked out, but many more remain for analysis before the story of vertebrate development is complete.

(This article is based upon a lecture presented to the embryology class in the auditorium of the Marine Biological Laboratory on June 26).

FIRST EVENING LECTURE PRESENTED BY DR. ASTBURY

The 1937 lecture series in the Marine Biological Laboratory opened on Tuesday, June 29, when Dr. W. T. Astbury of the University of Leeds, England, presented "The X-ray Interpretation of Protein Structure" before a large audience.

He described the physical manipulations whereby one protein could be so changed as to give the x-ray picture of a different one. With the aid of models, he illustrated his concept of the relationships of the various types of protein molecules and the intramolecular changes during the transformations. Hair could be stretched in the presence of water to give the x-ray pattern of silk fibroin, and on the other hand could be "supercontracted" to resemble myosin, while casein could be denatured and stretched to give a picture similar to that of hair.

The important economic and sociological applications of the concepts were pointed out by Dr. Astbury. The crease in trousers and the "permanent" in hair, which are results of localized transformations, return to the natural state when wet; the presence of water on the tongue of the tiger enables him to keep his fur in the most desirable conformation while he is "knocking about" at night. The importance of water was striking. Dr. Astbury playfully predicted coats from casein and hats from the crystalline tobacco virus, when transformation techniques are expanded. The lecture was given in such a manner as to provoke the rumor that Dr. Astbury was a paid government emissary sent to convince the American people that the English *have* a sense of humor.

Before introducing the speaker, Dr. F. R. Lillie, president of the Corporation, introduced himself as one who had risen in 27 year's attendance at the Laboratory from "powder monkey to admiral." As admiral, he maintained, he would exercise his prerogative of making a few remarks. He welcomed all workers, especially newcomers, to the advantages of the Laboratory and mentioned the desirability of not overlooking the recreational facilities of the region. Anyone would be "subhuman," said Dr. Lillie, who did not find an attraction in the pleasures of Woods Hole and the surrounding waters. Since this is the 50th session of the Marine Biological Laboratory, Dr. Lillie suggested that the semicentennial be celebrated by continuing in the usual way.

—*P. K.*

THE COURSE IN EMBRYOLOGY

DR. H. B. GOODRICH

Director of the Course and Professor of Biology, Wesleyan University

The embryology course opened on June 22. The work started with the development of fish, for which Fundulus supplies the principal material but comparisons are made with some pelagic eggs, such as those of the mackerel, cunner or scup. The order of program is based chiefly on the sequence of the breeding periods of the forms studied. Pelagic fish eggs are spawned early and their season is nearly over when the course commences. The schedule next calls for a study of development and regeneration in certain coelenterates which are also only obtainable early during the session. The fertilization of the egg of Nereis must be studied before the close of the breeding period which occurs during the "dark of the moon." Thus the program is built up without relation to phylogenetic classification but rather with reference to the availability of material.

The course aims to present a survey of the embryology of a fairly wide selection of marine forms, and to offer opportunity for the continuous observation of developmental processes as they occur in the living organism. In this latter respect opportunities are available which supplement the traditional methods of study of isolated stages from preserved and sectioned materials. It is also intended to outline various modern fields and methods of research in embryology. In this connection lectures given by various investigators are of great value. During the season of 1936, lectures of this type were given by C. R. Stockard, R. Chambers, S. Hörstadius, E. R. Clark, and J. Holtfreter.

One change is announced in the staff. Dr. Viktor Hamburger of Washington University is taking the work usually given by Dr. Grave.

EXTRA-CURRICULAR ACTIVITIES AT WOODS HOLE

M.B.L. CLUB NOTES

The M. B. L. Club started the season with an impromptu dance on Saturday, June 19 and the first concert was given on the following Monday. By the end of the week the shingling was finished and the debris cleared away for the formal opening of the season with the first mixer. Unique decorations of a marine motif and an unusually large attendance marked this year's gathering. The general mixing in the early part of the evening was followed by dancing until midnight. The committee in charge of the affair included Mrs. L. V. Heilbrunn, Miss M. Lucille Nason, Mr. H. N. Glassman and Mr. J. S. Rankin, Jr.

The club activities, as in former years, will include reading, music, dances, ping-pong, and in general social intercourse in a pleasant environment.

The music committee is featuring the music of Sibelius and Beethoven for the first eight Monday evening concerts. For lovers of chamber music a second series is planned for the available Thursday evenings at 8:00 P. M. This series will consist of sonatas, trios and quartets, with perhaps a few compositions for small orchestra and such suitable vocal recordings as are available. Owners of records who are willing to lend them to the club (*for one playing only*) are invited to communicate with S. E. Hill, Room Br 209, R. C. Stauffer, Room 101 Oceanographic or A. B. Novikoff, Old Main Building.

The repairs to the club were more expensive than anticipated, and still more work is needed, notably a resurfacing of the floor. It is important that the club have the full support of past members and as many new members as can be secured in order to finance the improvements and to extend the service of the club. Dues may be paid at the M. B. L. office, to any member of the executive committee or to Mr. Glassman: active members, $1.50; associate members, $3.00; students $1.00.

The Executive Committee consists of Chas. Packard, president; Laurence Irving, vice-president; Wm. Ballard, sec.-treas.; Mrs. J. K. W. Ferguson, chairman house committee; S. E. Hill, chairman music committee; Mrs. H. Specht, chairman dance committee; and F. J. Sichel.

Program for Concert—July 5, at 8:00 P. M. Mozart—Violin Concerto No. 5, Joseph Wolfstohl and Vienna Philharmonic; Sibelius—Symphony No. 2, Robert Kajanus and symphony orchestra; Beethoven—Symphony No. 6, Paul Paray and orchestra of Concerts Colonné.

TENNIS FACILITIES AT THE M. B. L.

In anticipation of a very active tennis season the M. B. L. Tennis Club contracted with Mr. H. V. Lawrence, of Falmouth, to have the Clay Court put in perfect condition by June 5th. The court was dug up to a depth of two inches, regraded for perfect drainage, and covered with pulverized stone. This court is in use from 8:00 A. M. until 8:00 P. M. on most days, and is now built to stand hard usage.

The Colas Courts near the beach are in very good condition, considering their exposure to hard winters. There will be some re-surfacing of the singles court during the summer. It is planned that within the next several years the fence around the Colas Courts will be re-placed by a more durable structure.

With an average membership of 150 per season the Tennis Club is faced with the rather urgent necessity of finding additional space for the building of a tennis court or of raising the dues to such a level as to restrict membership to its present maximum. All persons connected with the Marine Biological Laboratory are eligible to membership in the Club with full privileges, i.e., use of any of the four courts. Non-laboratory guest-members are admitted, upon payment of appropriate fees, to the use of the Colas Courts only. This restriction is imposed because the Club pays taxes only upon the Colas Court property, and the tax-free Clay Court can be used only by laboratory workers or their immediate families.

The membership dues for this season are $5.00 for the full membership and $4.00 for use of the Colas Courts only. Half season rates are $3.50 and $2.50 respectively.

Plans for this summer's activities include a series of tournaments, starting about the third week in July and ending with the Men's Single's Final match about the third week in August. This particular match should prove to be the best in the history of the Club for there are already among the membership three names that are associated with a brand of tennis seldom seen at Woods Hole. These are D. E. Lancefield, who first won the new men's singles trophy; J. Miller, who two years ago won the Falmouth Championship; and T. K. Ruebusch from Yale who demonstrates almost perfect stroking and has thus far squared matches with the other men mentioned. It is hoped that there will appear many more women contestants than are at present listed among the membership. The Tournament Cups are now on display in Mrs. Thompson's Store window.

Robert Rugh, *President*

The Collecting Net

A weekly publication devoted to the scientific work at marine biological laboratories

Edited by Ware Cattell with the assistance of C. P. Kraatz, Anna-Betty Clark, A. S. Cattell and Mary Goffin.

Entered as second-class matter July 11, 1935, at the U. S. Post Office at Woods Hole, Massachusetts, under the Act of March 3, 1879.

THE FUNCTION OF THE COLLECTING NET

This issue of The Collecting Net initiates its twelfth summer of publication; it is also the first of our "second hundred" numbers. We have always hoped for the wholehearted coöperation of every marine biologist in the conduct of this journal and it does not seem inappropriate at this time to indicate some of its values to marine biological laboratories and especially to the Marine Biological Laboratory. If the journal were conducted for profit, one might hesitate to ask biologists to aid in bringing out its weekly issues. As a matter of fact through its entire eleven years receipts above the actual cost of publication have been turned over to a scholarship fund. It is a matter of record that our organization has given grants totaling well over $3,000 to students at the Marine Biological Laboratory. We shall continue to award scholarships and look forward to building up gradually an endowment fund so that it will not be necessary to "raise" five hundred dollars each summer in order to assure the annual awards.

In other ways the contributions of The Collecting Net are of importance. It promptly prints lectures and seminars, often with the accompanying discussion. This material is made available while it is under consideration by the laboratory community and is especially useful to the student and the younger investigator.

The annual directory is of value to everyone connected with the laboratories in Woods Hole; it is of especial worth to the administrative offices which through it are relieved of the burden of answering countless questions. The journal acts as a medium for carrying official announcements and news of current events which would otherwise have only the bulletin board and the annual corporation meeting as outlets. It also serves as a medium for reporting the activities of the M. B. L. social and tennis clubs, and the Woods Hole Choral Society; in this way it contributes directly to their success.

In general, then, The Collecting Net, providing formal and informal news of the varied activities of the Woods Hole laboratories, is a factor in promoting acquaintance among the personnel and in maintaining *l'esprit de corps*. A coöperative scientific undertaking of this sort can be successful only insofar as it receives the undivided support of the scientific community. In the past it has enjoyed the very active interest of biologists at Woods Hole and elsewhere; it is without question that with such a continuing interest The Collecting Net will occupy a position of increasing importance to biologists everywhere.

Introducing

Jean L. A. Brachet, charge de cours, embryology, Brussels University, and fellow of the Rockefeller Foundation for Medical Research.

Dr. Brachet was born in Brussels, Belgium, in 1909. He entered the University of Brussels in 1927, receiving the degree of M. D. in 1934; a year later he was appointed demonstrator in anatomy at Brussels.

Each year students of the four Belgian universities hold a competition for a government fellowship, usually for study abroad. Dr. Brachet won this honor in 1933 with a paper on the nucleic acids in the sea urchin egg, but wishing to complete his medical work, did not accept it. In 1934, he again won this award for his work on the metabolism of frog eggs. He worked in the laboratory of Dr. Joseph Needham at Cambridge under the fellowship on the glycogen of frog eggs and urea excretions in bird eggs.

In 1936 the Francqui Foundation awarded a fellowship to Dr. Brachet to continue his study on nucleic acids at the Marine Biological Station at Naples. At this time he received a prize from the Royal Academy of Science.

On March 15, Dr. Brachet came to Princeton under a Rockefeller Foundation fellowship. Here, in collaboration with Dr. H. Shapiro, he published a paper on the metabolism of the organizer in *Rana sylvatica* and *Rana pipiens*. In Dr. E. N. Harvey's laboratory, he has been studying oxidation in isolated germinal vesicles of *Triturus pyrrhogaster*.

Dr. Brachet will return to Brussels in October to resume his lectures at the University.

Dr. Edward F. Adolh, associate professor of physiology in the University of Rochester Medical School, is spending six weeks in Nevada studying the effects of high temperature on man.

Prof. H. W. Stunkard, administrative chairman of the department of biology at New York University, attended the 25th anniversary of his graduation at Coe College, Iowa. At the commencement exercises he received the honorary degree of Doctor of Science.

ITEMS OF INTEREST

DR. P. B. ARMSTRONG, assistant professor of anatomy at Cornell University Medical School since 1930, has been appointed head of the department of anatomy in the School of Medicine, University of Alabama.

PROFESSOR AND MRS. RICHARD WEISSENBERG of Berlin, Germany, the former at the present time guest-professor in the Department of Cytology, Washington University School of Medicine at St. Louis, will arrive in Woods Hole about July 5. Professor Weissenberg will work at the Marine Biological Laboratory with Dr. E. V. Cowdry.

DR. KENNETH S. COLE, assistant professor of physiology at the College of Physicians and Surgeons since 1929, became associate professor on July 1.

DR. E. NEWTON HARVEY, professor of physiology at Princeton University, is sailing on July 15 to attend the International Psychological Congress in Paris. He will present a paper entitled "Conditioning of the Alpha Rhythm of the Brain to Auditory Stimuli."

DR. L. V. HEILBRUNN, associate professor of zoology at the University of Pennsylvania since 1929, is the author of a book, "An Outline of General Physiology," scheduled for publication at the end of this month.

DR. G. W. BEADLE, previously assistant professor of zoölogy at Harvard University, has been appointed professor of genetics at Stanford University.

Dr. Dugald E. S. Brown, assistant professor of physiology at New York University Medical College, left Woods Hole with his wife and two children on July 2nd. They will sail on the S. S. *President Harding* on July 28 for England where Dr. Brown will continue his work on the biological effects of high pressures in the laboratory of Dr. A. V. Hill at University College, London. The former will return for a portion of the second semester to lecture at New York University and will later rejoin his family in England where they will remain until fall.

A Get-Together "Dutch Treat" Picnic has been planned by a group of people from Washington University and St. Louis University, St. Louis, Missouri, who are spending the summer in Woods Hole. The date tentatively set, weather permitting, is Saturday, July 10. Mr. Gordon Moore, Br 234, is in charge of reservations. Individuals from either institution who would like to join the group, should get in touch with Mr. Moore at once.

The Woods Hole Choral Club begins its 11th season on Tuesday, July 6. Rehearsals will be held in the canteen opposite the mess on Tuesdays following the evening lecture, and on Thursdays at 8:00 P. M. The leader, Mr. Gorokhoff, has chosen a number of new and interesting compositions for the summer program. Those who enjoy singing are invited to join the club. There are no dues. Members may purchase the music at a cost of about $2.00. The annual concert will be given early in August.

WEDDINGS SINCE A YEAR AGO

Dr. A. A. Abramowitz and Miss Rosaline Kunitz; September 3, 1936; Hyannis, Mass.

Dr. Raymond Cable and Miss Mary Tupper; Dec. 26, 1936; Montclair, N. J.

Dr. Homer P. Smith and Miss Virginia Walker; May 30, 1937; Falmouth, Mass.

Mr. Martin D. Wollman and Miss Ilse Michaelis; June 5, 1937; New York.

Dr. F. R. Hunter and Miss Margaret Kershaw; June 5, 1937; Harwichport, Mass.

Mr. LeRoy H. Heller and Miss Betty Jenkins; June 9, 1937; Washington, D. C.

Mr. Roscoe Hughes and Miss Elizabeth Drumtra; June 10, 1937; Annisquam, Mass.

Dr. F. J. M. Sichel and Dr. Elsa Keil; June 10, 1937; Washington, D. C.

Mr. Russel F. Travis and Miss Charlotte E. Cairns; June 12, 1937; Fitchburg, Mass.

Mr. Charles W. Spooner, Jr. and Miss Vera Warbasse; June 26, 1937; Woods Hole, Mass.

CURRENTS IN THE HOLE

At the following hours (Daylight Saving Time) the current in the Hole turns to run from Buzzards Bay to Vineyard Sound:

Date	A. M.	P. M.
July 4	1:03	1:15
July 5	2:03	2:17
July 6	3:02	3:15
July 7	3:58	4:06
July 8	4:51	5:02
July 9	5:43	5:51
July 10	6:31	6:47
July 11	7:17	7:39
July 12	8:09	8:27
July 13	8:56	9:20

In each case the current changes approximately six hours later and runs from the Sound to the Bay.

HANDBOOK OF MICROSCOPICAL TECHNIQUE. Edited by C. E. McClung. Second Edition, revised and enlarged. Hoeber, New York. 698 pages.

This is a revised and considerably enlarged second edition of a work which has found considerable favor among investigators who are concerned with structures of microscopic dimensions. The present volume consists of the contributions of thirty-four specialists. Most of the articles are concise descriptions of the technical procedures followed by the authors. It is just this sort of information, usually to be gleaned only by consultation of numerous papers, that makes a handbook of this type widely useful.

A number of chapters on special methods deal exclusively with the study of the microscopic structure of living, unfixed material. A section on Micrurgical Technique by Robert Chambers and M. J. Kopac is excellently illustrated by diagrams and photographs of the apparatus used in this work; and the text is so explicit in its directions that this section should well serve the function of a laboratory guide to the delicate manipulations of microdissection and microinjection. Equally good are chapters on the similar, but less delicate, free-hand methods by Sven Hörstadius and H. McE. Knower. Accessory to this material are a chapter on the Fused Quartz Rod Method of Illuminating Living Structures for Microscopic Study, and one on the Centrifuge Microscope by Ethel Browne Harvey. Gordon H. Scott has contributed a section on the Microincineration Method of Demonstrating Mineral Elements in Tissues.

Over one-third of the book is devoted to special histological methods. In these chapters the procedures given include such complete details of apparatus, reagents, and manipulation that one with limited technical experience should be able to acquire skill in these more difficult methods. Raphael Isaac's chapter on Methods of Studying Red Blood Cells includes excellent descriptions of all the standard methods of hematology; while the techniques for studying cytological details of leucocytes are considered separately by Ethel M. Slider and Hal Downey. There is also a chapter on Supravital Staining of Blood Cells by Florence Sabin. Methods of demonstrating the microscopic structure of connective tissues are presented at length by F. B. Mallory and Frederick Parker, Jr., and in a separate chapter on Bone by P. G. Shipley. The very special technique necessary in dental histology is described by H. R. Churchill and J. T. L. Appleton. The extremely complicated methods used by neurohistologists are exhaustively considered in sections by W. H. F. Addison, by William C. Gibson, and by Wilder Penfield and William Cone.

There is a chapter on Protozoological Methods by D. H. Wenrich. Bacteriological Methods are described by H. J. Conn, F. B. Mallory and Frederick Parker, Jr. There is a short chapter on Cytological Methods by C. E. McClung, E. Allen, R. T. Hance, J. W. McNabb, and E. V. Cowdry. The section dealing with the technique for cytoplasmic structures is adequate, but it seems to this reviewer that a consideration of methods of study of nuclear structures can hardly be considered up-to-date if the Feulgen test and the Aceto-carmine method together receive but half a page, while three pages are devoted to the matter of dehydration of tissues. Details of both procedures can be found in other sections of the book, but in view of the wide use of these techniques by cytogeneticists it appears that they should certainly receive more emphasis in the chapter on Cytological Methods.

There is a useful chapter on stains and staining, giving the chemical structure and schedules for use of most of the common dyes; and another section deals with fixation and fixatives in a similar encyclopedic manner. William Randolph Taylor has contributed a long, carefully written article on General Botanical Mictrotechnique, which includes some special methods as well.

There is a very brief chapter, of seven pages, on Embryological Methods by C. E. McClung, Ezra Allen, and Ruth McClung Jones. Comparing this with the contributions dealing with histological methods one cannot escape the feeling that this chapter is rather limited in scope and is probably inadequate for the requirements of those who wish to make microscopical preparations in connection with embryological researches.

In the preface the Editor states that the book attempts to meet two general needs. "The first is that of the inexperienced worker who requires specific directions which he may apply with confidence to the general run of material, with the exception of getting desired results. The other requirement is that of the experienced investigator who seeks the latest approved methods for the accomplishment of special technical results." From the resumé it should be apparent that the "Handbook of Microscopical Technique," because of the sections on special methods which constitute the subject matter of Part II, is likely to be extremely useful to many experienced investigators. Part I is a short section by the Editor, which he states is designed to fulfill the needs of the inexperienced worker. Presumably this means individuals like college undergraduates, who have had no previous experience in preparing material for microscopic study. Part I does not seem well adapted to this use since, instead of giving "specific directions," the author, for the most part, discusses the preparation of material for microscopic study in a very general manner, explaining the purposes of each step and mentioning various possible methods of achieving this desired result. From his experience in teaching this subject this reviewer feels that it would be indeed a very exceptional student who by study of Part I of the "Handbook of Microscopical Technique" could devise an effective schedule for preparation of even a simple slide of liver stained with hematoxylin and eosin.—*A. W. P.*

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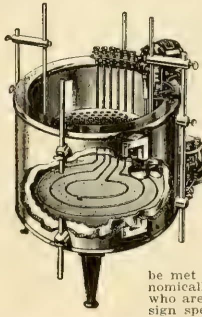

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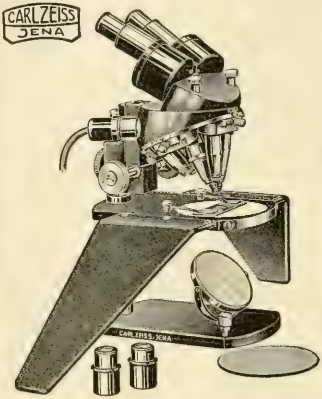

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NOTES AND NEWS FROM M. B. L. CLASSES

PHYSIOLOGY CLASS NOTES

This bulletin is in the way of an advance notice on the activities of the physiology course. Not having had our picnic yet, we really have little to report but promise to keep eyes and ears open for the future.

To date we have had the pleasure of hearing excellent lectures from Drs. Prosser, Ferguson, and Fisher on subjects ranging from brain waves to electroplates. In addition we had a special lecture from Dr. D. E. S. Brown on "Biological Reactions to High Pressure," from which we learned that there is quite a large population below 500 fathoms so that Davy Jones' locker is probably a gayer place than the depths above and has a continuous night life.

The class has been divided into 6 groups for the first two weeks. Of the various cares and worries encountered, Dr. Ferguson's students have apparently met the worst. They are trying to invent a muzzle to prevent him from eating all their supply of yeast. Unless a remedy can soon be found the work on carbonic anhydrase and on the Warburg and Thünberg techniques must come to an untimely close.

Dr. Fisher's students work day and night on cellular respiration and wonder if he ever goes swimming. His first group thought they were working hard when they followed the changes in heart rate of one Fundulus egg apiece in response to treatment with cyanide, carbon monoxide and oxygen-lack. Then Dr. Ohnell came over from Sweden and showed up Americans for pikers by keeping track of 62 at once.

Dr. Prosser gave us a bang-up demonstration of what Roosevelt should be considering instead of Pasanaquaddy and T.V.A. If all the torpedo fish could be placed end to end and be persuaded to bite each others' tails, they might cause electrolysis of the ocean. At any rate the demonstration looked very promising. The fish rang a bell and displayed his action potentials on the cathode ray oscillograph whenever his tail was twisted. On being asked why a torpedo fish was called a torpedo fish when it didn't look a bit like a torpedo, Dr. Prosser answered sadly that it certainly felt like one.

Tuesday the 29th, Dr. Prosser gave us another demonstration of action potentials and oscillograph recording, sacrificing his own arm to the cause of science. Dr. Sichel showed us the contraction of a single muscle fiber and gave a good example of what can be done with a Chambers micromanipulator. Both shows went off splendidly. Tomorrow we all change to something new but of that next-time.

People sometimes wonder what physiologists do on Sunday. If any tendencies are shown for the future of these amateurs we should judge that some will go up in the air, some will go down in the water, a few will keep their feet on the ground, but by far the greater part will be found at the movies, ardent devotees of the three Marx Brothers, lending dignity to the cause of greater drama by their presence. —E. H. and H. M.

EMBRYOLOGY CLASS NOTES

On Tuesday, June 22, thirty-five prospective embryologists from twenty-seven different institutions met for the first lecture of the summer. Dr. H. B. Goodrich of Wesleyan University, started the course with an outline of Teleost development. On Saturday, June 26, Dr. Jane W. Oppenheimer spoke on the subject of experimental analysis of the development of the presumptive regions of the Teleost egg. After her lecture, Miss Oppenheimer demonstrated her method of vital staining parts of Fundulus eggs and how to graft bits of blastoderm on to other eggs.

Monday, June 28, Dr. P. B. Armstrong discussed function in the developing heart of Fundulus, concluding his talk with moving pictures showing the inhibiting effect of acetyl choline on an innervated heart and the lack of any inhibiting effect on a non-innervated heart.

The laboratory work has consisted so far of a rather complete study of the early stages of the development of both the pelagic and non-pelagic Teleost eggs. From Saturday until Monday the members of the class have been doing individual research on various problems, such as the effect of adrenalin on the heart rate of a Fundulus embryo, vital staining for specific tissues, result of injury of one blastomere in a two-cell Fundulus egg, ways of producing twins, effect of sea water, fresh water, and distilled water on the development of Fundulus eggs, optimum concentration of sea water for the viability of sperm, and inheritance of chromatophore patterns. Most of the class are still figuring out the course of the blood in the 6-day Fundulus embryo.

Plans for social activities are getting under way, and a embryology baseball team is being organized by Eugene Copeland, capable of accepting any and all challenges from any group in the M. B. L. —BARBARA H. LEONARD

PROTOZOOLOGY CLASS NOTES

On Saturday, June 19th, Dr. G. N. Calkins began his lectures with an account of the founding of the Marine Biological Laboratory at Penikese by Louis Agassiz, and its subsequent establishment at Woods Hole. During the following week, Dr. Calkins continued his lectures with a survey of the various classes of Protozoa. On Tuesday, June 29, Dr. G. Kidder delivered the first seminar on the early concept of protozoology.

DIRECTORY FOR 1937

KEY

Laboratories	
Botany Building	Bot
Brick Building	Br
Lecture Hall	L
Main Room in Fisheries Laboratory	M
Old Main Building	OM
Rockefeller Bldg.	Rock

Residence	
Apartment	A
Dormitory	D
Drew House	Dr
Fisheries Residence	F
Homestead	Ho
Hubbard	H
Kahler	Ka
Kidder	K
Whitman	W

In the case of those individuals not living on laboratory property, the name of the landlord and the street are given. In the case of individuals living outside of Woods Hole, the place of residence is given in parentheses.

MARINE BIOLOGICAL LABORATORY

INVESTIGATORS

Abell, R. G. instr. anat. Pennsylvania Med. Br 117. Densmore, School.

Abramowitz, A. A. res. asst. biol. Harvard. Br. 312. (W. Falmouth).

Algire, G. H. fel. anat. Maryland Med. Rock 6. Young, West.

Amberson, W. R. prof. phys. Tennessee Med. Br 109. Gansett.

Andersch, Marie A. asst. prof. biochem. Woman's Med. (Philadelphia) Br 313. Bosworth, North.

Anderson, R. L. prof. biol. Johnson C. Smith. Rock 2. K 14.

Andrew, W. teach. fel. anat. Georgia Med. Br 217. Hilton, Water.

Appel, F. W. assoc. prof. embr. St. John's. Bot 1. Daniels, Millfield.

Armstrong, Louise S. res. asst. zool. Cornell Med. Br 318. D 215A.

Armstrong, P. B. asst. prof. anat. Cornell Med. Br 318. D 215A.

Ballentine, R. Princeton. Br 231. Smith, East.

Barry, A. grad. asst. biol. Harvard. Br 312. Dr 2.

Barth, L. G. asst. prof. zool. Columbia. Br 122c. D 206.

Bauer, K. F. privatdozent. anat. Berliin. Br 206. Sylvia, Buzzards Bay.

Beadle, G. W. asst. prof. genet. Harvard. Br 332. Shaffner, Millfield.

Black, E. C. dem. exp. biol. Toronto. Br 107. Ka 1.

Bogdanovitch, S. B. asst. pharm. Beograd Med. (Yugoslavia) OM 40. A 104.

Brachet, J. L. A. chargé de cours embr. Brussels. Br 127. D 102.

Briggs, R. W. grad. asst. biol. Harvard. Br 312. Dr 2.

Brill, E. R. grad. biol. Harvard. Br 312. Cassidy, Millfield.

Bronfenbrenner, J. J. prof. bact. Washington Med. (St. Louis) Br 234. Quisset.

Buchheit, J. R. asst. res. cyt. Lilly Res. Labs. Br 319. Howe, Quisset.

Cable, Mary T. grad. bact. Purdue. Br 126. D 314.

Cable, R. M. asst. prof. parasitol. Purdue. Br 126. D 314.

Calkins, G. N. prof. protozool. Columbia. Br 331. Buzzards Bay.

Cameron, J. A. C. asst. prof. zool. Missouri. OM 5. Young, West.

Cannan, R. K. prof. chem. New York Med. Br 309. Gardiner.

Chambers, A. H. grad. phys. Pennsylvania. Br 339. D 112A.

Cheney, R. H. prof. biol. Long Island. Br 118. A 302.

Claff, C. L. ind. invest. protozool. (Randolph, Mass.) OM 32. A 208-9.

Clark, Eleanor L. volun. res. anat. Pennsylvania. Br 117. West.

Clark, E. R. prof. anat. Pennsylvania. Br 117. West.

Clark, Frances M. sec. to Dr. Clowes. Lilly Res. Labs. Br 328. D 103.

Clowes, G. H. A. dir. Lilly Res. Labs. Br 328b. Nobska.

Cohen, A. res. fel. zool. Yale. Br 217e. D 112.

Cole, K. S. asst. prof. phys. Col. Phys. & Surgeons. Br 114. D 313.

Commoner, B. grad. zool. Columbia. Br 314. Wilde, Gardiner.

Copeland, D. E. asst. biol. Amherst. OM 41. K 7.

Cowdry, E. V. prof. cytol. Washington (St. Louis) Br 329. Millfield. .

Crowell, P. S., Jr. instr. zool. Miami. OM 34. Bar Neck.

Curtis, H. J. assoc. phys. Columbia Med. Br 114. D 105.

Davson, H. demonstr. biophysics. University College (London). Br 310. A 203.

Denny, Martha. instr. zool. Connecticut. Bot 1. Grinnell, Bar Neck.

de Rényi, G. S. assoc. prof. anat. Pennsylvania Med. Br 221. Conklin, High.

Dethier, V. G. grad. zool. Harvard. OM Base. (Buzzards Bay).

Donnellon, J. A. grad. zool. Pennsylvania. OM Base. Mendel, High.

Drouet, F. res. fel. bot. Yale. Bot 13. Young, West.

Dziemian, A. J. asst. instr. phys. Princeton. Br 231. Ka 22.

Eggleston, Nancy M. Mt. Holyoke. Br 318. Veeder, West.

Ferguson, J. K. W. asst. prof. phys. Ohio State. Br 108. D 214.

Fischer, E. assoc. prof. phys. & pharm. Virginia Med. Br 214. Hilton, Main.

Fisher, K. C. instr. zool. Maine. Br 107. Ka 1.

Freeman, A. M. Vanderbilt Med. Br 122d. Hamblin, Main.

Frisch, J. A. prof. biol. Canisius. Br 217i. Mendel, High.

Fry, H. J. visit. invest. cytol. Cornell Med. OM Base. Purdum, Little Harbor.

Garrey, W. S. prof. phys. Vanderbilt Med. Br 215. Gardiner.

Gehenio. Sister Pierre M. grad. fel. biol. St. Louis. OM 38. White, Water.

Glassman, H. N. res. asst. phys. Pennsylvania. Br 205. Ka 1.

Goessling, Margaret S. sec. to Dr. Cowdry. Washington Med. (St. Louis) Br 329. Albany, Millfield.

Goldin, A. grad. asst. zool. Brooklyn. OM 39. Ka 2.

Goodrich, H. B. prof. biol. Wesleyan. Br 210. D 107.

Grave, C. prof. zool. Washington (St. Louis). Br 327. High.

Guttman, Rita. grad. phys. Physicians & Surgeons. Br 313. Hilton, Main.
Hamburger, V. asst. prof. zool. Washington (St. Louis). OM 3. Gigger, Park.
Hamdi, T. N. Pennsylvania Med. Br 214. Crowell, Main.
Harris, D. L. instr. zool. Pennsylvania. Br 111. Edwards, School.
Harvey, E. N. prof. phys. Princeton. Br 116. Gosnold.
Harvey, Ethel B. indep. invest. Princeton. Br 116. Gosnold.
Haywood, Charlotte. assoc. prof. phys. Mt. Holyoke. Br 336. A 206.
Heilbrunn, L. V. assoc. prof. zool. Pennsylvania. Br 220. Edwards, School.
Hendee, Esther C. instr. biol. Russell Sage. Bot 1. H 8.
Hiestand, W. A. asst. prof. phys. Purdue. Br 126. Elliott, Center.
Hill, E. A. instr. biochem. Washington Med. (St. Louis). Br 207. D 316.
Hill, S. E. asst. gen. phys. Rockefeller Inst. Br 209. Veeder, West.
Hinchey, M. Catherine. grad. zool. Pennsylvania. Br 228. A 307.
Höber, R. visit. prof. phys. Pennsylvania. Br 313. D 301A, B.
Hobson, L. B. grad. asst. zool. Cincinnati. L 26. Ka 22.
Hodapp, E. L. grad. fel. biol. St. Louis. OM 38. White, Water.
Hopkins, D. L. asst. prof. zool. Duke. Bot 5. (Falmouth).
Horowitz, N. H. fel. emb. California Inst. Tech. Br 315. Ka 21.
Horvath, S. M. grad. asst. phys. Ohio State. Br 108. Dr 6.
Hughes, Elizabeth Drumtra. instr. biol. Wilson. OM 22. K 8.
Hughes, R. D. grad. asst. zool. Columbia. Br 314. K 8.
Hunninen, A. V. prof. biol. Oklahoma City. Br 217. Dr 3.
Hunter, Laura N. instr. zool. Pennsylvania Col. for Women. Br. 217b. W F.
Hutchens, J. instr. biol. Hopkins. Br 325. Ka 23.
Irving, L. prof. biol. Swarthmore. Br 107. "The Snix". Eel Pond.
Jacobs, M. H. prof. phys. Pennsylvania. Br 102. (Sippewissett).
Jenkins, G. B. prof. anat. George Washington Med. OM 46. Gosnold.
Johlin, J. M. assoc. prof. biochem. Vanderbilt Med. Br 122d. Park.
Johnson, F. H. Lilly res. fel. phys. Princeton. Br 127. Lucké, Minot.
Kalmanson, G. M. grad. bact. Washington (St. Louis). Br 234. Bosworth, North.
Keefe, E. L. res. asst. Washington (St. Louis). OM 3. Ka 4.
Keil, Elsa (Mrs. F. J. Sichel) asst. prof. phys. Rutgers. Br 339. K 9.
Keltch, Anna K. res. chem. Lilly Res. Labs. Br 319. Howe, Quisset.
Kidder, G. W. instr. biol. City of New York. OM 21. Oak, Park.
Knower, H. McE. res. assoc. biol. Yale. Compton, Millfield.
Knowlton, F. P. prof. phys. Syracuse Med. Br 226. Gardiner.
Korr, I. M. instr. phys. New York Med. Br. 127. Röhmeling, Pleasant.
Krahl, M. E. res. chem. Lilly Res. Labs. Br 333. Taft, Minot.
Kreezer, G. res. assoc. electrophys. Training Sch. (N. J.) Br 304. Nickerson, Millfield.
Kreig, W. instr. anat. New York Med. Br 315 (Sippewissett.)
Lancefield, D. E. assoc. prof. zool. Columbia. Br 335. Mast, Minot.
Lancefield, Rebecca C. assoc. bact. Rockefeller Inst. Br 208. Mast, Minot.
Law, L. W. grad. asst. genet. Harvard. Br 332. Johnson, Millfield.
Levenson, A. S. grad. phys. Pittsburgh. Rock 7. Ka 24.
Lillie, F. R. prof. embr. emer. Chicago. Br 101. Gardiner.
Lillie, R. S. prof. gen. phys. Chicago. Br 326. Gardiner.
Lipman, H. J. grad. asst. phys. Pittsburgh. Rock 7. Ka 21.
Loeb, L. prof. path. emer. Washington Med. (St. Louis). L. 28. Sands, Gosnold.
Loeffler, L. prof. path. Middlesex (Mass.) L. 29. Wilde, Gardiner.
Luyet, B. J. prof. biol. St. Louis. OM 38. Mendel, High.
Lyon, Rhea C. res. techn. anat. Maryland Med. Rock 6. Smith, East.
Macdougald, T. J. Rockefeller fel. cytol. Washington Sq. (N. Y. U.) Br 340. D 217.
Mathews, A. P. prof. biochem. Cincinnati. Br 341. Buzzards Bay.
Mavor, J. W. prof. biol. Union. Bar Neck.
Mayo, Virginia grad. biol. Radcliffe. Br 213. H 8.
Mazia, D. fel. zool. Pennsylvania. Br 110. Edwards, School.
Menkin, V. instr. expt. path. Harvard Med. Br 303. Ficus, Quisset.
Michaelis, L. mem. Rockefeller Inst. Br 207. Dantchakoff, Gansett.
Miller, Faith S. indep. invest. zool. Ohio. Br 111. K 12.
Miller, J. A. instr. zool. Ohio. Br 111. K 12.
Moore, G. F. Washington Med. (St. Louis). Br 234. Dr 5.
Moore, J. A. grad. asst. zool. Columbia. Br 314. Dr 8.
Morris, Marion C. instr. bact. Washington Med. (St. Louis). Br 234. Neal, Bar Neck.
Morris, S. res. zool. Biological Inst. (Philadelphia). Br 217m. Dr 9.
Moser, F. grad. biol. Pennsylvania. Br 220. Stevenson, School.
Nebel, B. R. res. assoc. cytol. New York State Agr. Expt. Sta. Br 204. D 106.
Nonidez, J. asst. prof. anat. Cornell Med. Br 318. Whitman.
Novikoff, A. B. tutor biol. Brooklyn. OM 1. Wilde, Gardiner.
O'Brien, J. P. res. asst. Hopkins OM 1. Mendel, High.
Öhnell, R. F. res. asst. med. Karolinska Inst. (Stockholm). OM 9. Dr 2.
Olson, M. res. asst. zool. Minnesota. Br 111. Ka 4.
Orr, P. R. instr. biol. Brooklyn. L 32. Macbeth, Glendon.
Packard, C. asst. prof. zool Columbia. OM 2. North.
Parker, G. H. prof. zool. emer. Harvard. Br 213. A 308.
Parmenter, C. L. assoc. prof. zool. Pennsylvania. Br 221. D 201.
Parpart, A. K. asst. prof. phys. Princeton. Br 231. Jacobs, Minot.
Peabody, Elizabeth B. prof. biol. St. Elizabeth (N. J.). L 24. Cassidy, Millfield.
Pierce, Madelene E. instr. zool. Vassar. L 22. Grinnell, Bar Neck.

Pollister, A. W. asst. prof. zool. Columbia. Br 335. A 107.
Porter, K. R. grad. asst. Harvard. Br 312. Dr 2.
Potter, T. S. res. assoc. med. Chicago. Bot 4. Buzzards Bay.
Poulson, D. F. instr. zool. Yale, Br 110.
Prosser, C. L. asst. prof. phys. Clark. Br 339. Robinson, School.
Richards, O. W. res. biol. Spencer Lens. Br 8. A 303.
Riehl, Doris grad. chem. Yale. Br 122. Stevenson, School.
Ritchie, L. S. instr. biol. North Carolina. OM 33. Hilton, Main.
Robertson, Lola E. res. asst. zool. New York. Br 232. H 3.
Robeson, J. M. asst. prof. zool. Syracuse. Br 217h. boat 8D284.
Root, R. W. asst. prof. biol. City of New York. L 31. Sylvia, School.
Rose, S. M. grad. asst. zool. Columbia. Br 314. Taylor, Whitman.
Rosenfield, R. Pittsburgh Med. Rock 7. Ka 21.
Ruebush, T. K. instr. biol. Yale. Br 217d. D112.
Rugh, R. instr. zool. Hunter. OM 44. Hubbard, East.
Russell, Alice M. instr. zool. Pennsylvania. OM base. Gray, Buzzards Bay.
Sauer, Mary Elmore instr. micr. anat. Alabama. Br 217c. Bosworth, North.
Schaeffer, A. A. chair. dept. biol. Temple. Br 228. D 203.
Scharrer, Berta res. asst. neurol. Neurologisches Inst. (Frankfurt). Br 204. D 315A.
Scharrer, E. asst. neurol. Neurologisches Inst. (Frankfurt). Br 204. D 315A.
Schechter, V. instr. biol. City of New York. Br 111. Dr 6.
Schenthal, J. E. res. fel. anat. Maryland Med. Rock 6. Young, West.
Schmidt, Ida G. asst. prof. anat. Cincinnati Med. Bot 3. Metz, Hyatt.
Schmidt, L. H. res. fel. biochem. Cincinnati Med. Bot 3. Metz, Hyatt.
Schoenborn, H. W. grad. asst. biol. New York. L 25. Ka 2.
Schram, Mildred W. S. sec. Int. Cancer Res. Found. Br 305. Gardiner.
Scott, A. C. instr. biol. Union. OM Base. Metz, Hyatt.
Scott, Sister Florence M. prof. zool. Seton Hill. OM Base. Goffin, Millfield.
Shannon, J. A. asst. prof. phys. New York Med. Br 110. Swain, Millfield.
Shaw, Myrtle A. sen. bact. New York State Dept. Health. Br 122b. D 303.
Sichel, F. J. M. instr. phys. Howard Med. Br 339. K 9.
Slifer, Eleanor H. assoc. zool. Iowa State. Br 217a. D 306.
Smith, C. C. fel. biochem. Cincinnati Med. Br 341. Dr 2.
Smith, J. A. instr. biol. Hopkins. Br 217j. Ka 23.
Smith, R. D. asst. phys. Pittsburgh. Rock 7. Ka 24.
Snider, R. S. grad. anat. Washington (St. Louis). Br 329. Albany, Millfield.
Solandt, D. Y. asst. prof. phys. Toronto. OM 7. D 212.
Solberg, A. N. fel. zool. Columbia. Br 314. Metz, Hyatt.
Spencer, J. M. res. asst. phys. Columbia Med. Br 114. D 110.
Steinbach, H. B. instr. zool. Minnesota. Br 122c. Edwards, School.
Stoudt, H. N. grad. bot. Hopkins. Bot 1. Erskine, Glendon.
Stunkard, H. W. prof. biol. New York. Br 232. Buzzards Bay.
Sturtevant, A. H. prof. genet. California Inst. Tech. Br 332. Agassiz.
Summers, F. M. asst. prof. biol. Bard. Br 217k. Acorn, Park.
Taft, C. H., Jr. assoc. prof. pharmacology. Texas Med. L 23. Minot.
Tashiro, K. Cincinnati Med. Br 341. Park.
Tashiro, S. prof. biochem. Cincinnati Med. Br 341. Park.
Thornton, C. S. asst. prof. biol. Kenyon. Br 315. Röhmeling, Pleasant.
Toro, E. Rockefeller fel. anat. Columbia. Br 340. D 307-8.
Trost, Thelma S. asst. genet. Pennsylvania. OM 43. W B.
Turner, Abby H. prof. phys. Mt. Holyoke. Br 336. A 205.
Tyler, A. instr. embr. California Inst. Tech. Br 315. D 202.
Uhlenhuth, E. prof. anat. Maryland Med. Rock 6. Brooks.
Wagner, Carroll E. res. tech. anat. Maryland Med. Rock 6. Smith, East.
Walker, R. instr. biol. Rensselaer Poly. Inst. OM 44. Dr 10.
Warren, M. R. grad. asst. zool. Cincinnati. L 26. Ho 106.
Whiting, Anna R. guest invest. genet. Pennsylvania. OM 43. Minot.
Whiting, P. W. assoc. prof. genet. Pennsylvania. OM 43. Minot.
Wichterman, R. instr. biol. Temple. Br 217n. D 101B.
Wilbur, K. M. grad. zool. Pennsylvania. Br 220. Edwards, School.
Wilhelmi, R. W. grad. asst. biol. New York. Br 232. Ka 2.
Wilson, E. B. prof. zool. emer. Columbia. Br 322. Buzzards Bay.
Wilson, May G. asst. prof. pediatrics. Cornell Med. Br 217. Gardiner.
Wolf, E. A. assoc. prof. biol. Pittsburgh. Rock 7. Elliots, Center.
Wolf, Opal M. asst. prof. biol. Goucher. Bot 2nd. Cassidy, Millfield.
Worley, Elizabeth Kinney lect. zool. Barnard. OM 39. D 204.
Worley, L. G. instr. biol. Brooklyn. OM 39. D 204.
Young, Dixie asst. prof. zool. Oklahoma. Br 323. A 306.
Young, Roger A. asst. prof. zool. Howard. Br 315. A 304.
Young, S. B. techn. gen. phys. Rockefeller Inst. Br 209. D 218.
Zwilling, E. teach. asst. zool. Columbia. Br 314. K 15.

STUDENTS

Alsup, F. W. grad. zool. Fiske. embr. Dr 2.
Angell, Nancy. Bryn Mawr. embr. Veeder, Gardiner.
Belcher, Jane C. grad. zool. Columbia. proto. H. 9.
Black, E. C. dem. exp. biol. Toronto. phys. Ka 1.
Blanc, R. asst. biol. Amherst. embr. K 5.
Bozeman, Martha L. asst. genet. Illinois. embr. H 7.
Bridgman, Jane. grad. zool. Yale. phys. W G.
Brooke, M. M. instr. biol. Emory Jr. proto. D 112.
Caldwell, J. J. teach. biol. Grand Falls H. S. (Canada) proto. Dr 14.
Chasnoff, Ida. grad. biol. Teachers, Columbia. proto. D 106.
Christhilf, S. M. St. John's embr. Dr 10.
Cleverdon, M. Ardelle. stud. asst. zool. Oberlin. embr. W F.
Cornman, I. fel. biol. New York. embr. K 5.
Culbreth, Sarah E. instr. biol. Duke. phys. H 3.
Dienes, Priscilla A. Radcliffe. embr. W C.
Dropkin, V. H. grad. zool. Chicago. proto. Dr 7.

Evans, D. grad. asst. zool. Northwestern. phys. Ka 3.
Farney, Esther Kansas Med. phys. D 109.
Fetcher, E. S., Jr. physic. chem. Rockefeller Inst. phys. McInnis, Quisset.
Fippinger, Esther A. Hunter. proto. H 1.
Fogel, P. J. teach. biol. Morristown H. S. (N. J.) embr. MacKenzie, Pleasant.
Friedman, S. grad. zool. Washington Sq. (N. Y. U.) embr. McLeish, Millfield.
Grant, W. C. Wesleyan. phys. K 6.
Green, Susan A. prof. biol. Maryville. proto. Hilton, Glendon.
Griffiths, R. B. Rochester. embr. Dr 7.
Gross, Charlotte C. teach. biol. Union H. S. (N. J.) embr. H 6.
Gurley, Mary K. lab. asst. Col. Physicians & Surgeons. prot. D 106.
Hartwell, Mary A. teach. Riverhead H. S. (Long Island). proto. K 3.
Hatch, Cleora C. Radcliffe. embr. W H.
Hiatt, E. P. instr. biol. Wilmington (Ohio). phys. Dr 5.
Hock, C. W. grad. bot. Pennsylvania. phys. Albany, Millfield.
Huntington, Margaret O. Washington Med. (St. Louis). phys. W I.
Kellogg, Margaret P. Smith. embr. W G.
Kotcher, E. Wesleyan. embr. K.
Kraft, Jean C. grad. zool. Northwestern. embr. H 7.
Lambert, Barbara C. grad. asst. phys. Mt. Holyoke. phys. H 2.
Leonard, Barbara H. stud. asst. zool. Oberlin. emb. W A.
Logan, A. H. Washington & Jefferson. embr. Dr 1.
Loukides, J. H. Rutgers. proto. McLeish, Millfield.
Mackenzie, M. B. McGill. embr. Elliot, Center.
Meigs, J. F., Jr. Harvard. proto. Ka 3.
Milford, J. J. asst. biol. New York. embr. Bosworth, North.
Molter, J. A. instr. biol. Notre Dame. embr. Mendel, High.
Moore, W. G. asst. zool. Minnesota. embr. Ka 4.
Moorman, A. E. asst. zool. Northwestern. embr. Ka 2.
Morgan, Gwendolynn W. Sarah Lawrence. embr. D 207.
Nebel, B. R. res. assoc. N. Y. State Agr. Expt. Sta. phys. D 106.
Neel, J. V. asst. biol. Rochester. embr. K 1.
Nichols, F. Elizabeth De Pauw. embr. H 1.
Noyes, Barbara C. grad. zool. Columbia. proto. K 3.
Patterson, J. L., Jr. Virginia Med. phys. D 216.
Ravitz, L. A. grad. zool. Wisconsin. phys. Dr 1.
Safford, Virginia. techn. Hankin Labs. phys. Vincent, East.
Schlossman, A. grad. zool. Columbia. proto. Bosworth, North.
Smith, Elizabeth T. asst. zool. Northwestern. embr. H 7.
Smith, Elizabeth W. Oberlin. phys. H 4.
Smith, Marian Washington (St. Louis) embr. H 4.
Snider, Hester B. grad. zool. Columbia. proto. Grinnell, Bar Neck.
Streett, J. C., Jr. Princeton. embr. Dr 1.
Uhrich, J. fel. zool. Chicago. embr. F. R. Lillie, Gardiner.
Voter, Muriel A. Wheaton. prot. H 6.
White, Elizabeth C. grad. zool. Columbia. proto. H 9.
White, Elizabeth L. Goucher. embr. H 7.
Williams, C. F. De Pauw. embr. K .
Williams, C. R. grad. zool. Illinois. embr. Mendel, High.
Wright, Elsie S. grad. zool. Hopkins. embr. Jacobs, Buzzards Bay.
Wrightington, Margaret. Vassar. embr. Grinnell, Bar Neck.

WOODS HOLE OCEANOGRAPHIC INSTITUTION

Abramowitz, A. A. res. asst. biol. Harvard. 122. (Falmouth Heights).
Bonnet, D. D. Harvard. 108. Vincent, East.
Brand, T. von fel. helminth. Hopkins School of Hygiene. 105. Nickelson, Main.
Bumpus, D. F. grad. asst. phys. Brown. 108. Cowey, School.
Carey, Cornelia L. asst. prof. bot. Barnard. 209. Quisset.
Carritt, D. E. Rhode Island State. 109. Young, Middle.
Clarke, G. L. instr. biol. Harvard. 108. Woodcock, North.
Coker, C. M. grad. asst. zool. North Carolina. 211. Clapp, Gardiner.
Emmel, V. M. grad. asst. biol. Brown. 109. Cowey, School.
Hardman, Yvette grad. bact. Minnesota. 209. Norton, Quisset.
Herrick, C. E. Brown. 109. Young, Middle.
Hervey, R. J. grad. bot. Washington (St. Louis). 211. Young Middle.
Hisaw, F. prof. zool. Harvard. 106. (July).
Hotchkiss, Margaret instr. bact. New York Med. 202. Veeder, Millfield.
Hsiao, S. C. grad. zool. Harvard. (July).
Iselin, C. asst. curator oceano. Museum of Comp. Zool. (Harvard). 206.
Ketchum, B. H. grad. asst. phys. Harvard. 101. Snow, High.
Kraus, K. Harvard. 207. Young, Middle.
Leavitt, B. B. teach. Berkshire School (Sheffield, Mass.). 301. (Cataumet).
Lillick, Lois grad. asst. bot. Michigan. (Aug.).
Mitchell, P. H. prof. phys. Brown. 315. Orchard.
Montgomery, R. jun. meteorol. statistian U. S. dept. Agr. 208. Whitman.
Nunnemacher, R. F. asst. biol. Harvard. 314. Club Alfred, North.
Parker, Frances L. res. asst. micropaleont. Cushman Lab. 212. Swain, Millfield.
Parker, G. H. prof. zool. emer. Harvard. 106. A308.
Phleger, F. B. trav. fel. geol. Harvard. 212. Nickelson, Main.
Rakestraw, N. W. assoc. prof. chem. Brown. 109. Mitchell, Orchard.
Redfield, A. C. chair. biol. Harvard. 102. Millfield.
Renn, C. E. instr. biol. Harvard. 1. Club Alfred, North.
Sawyer, W. R. asst. prof. phys. chem. Royal Military (Canada). 111. Baitsell, Brooks.
Sears, Mary asst. oceano. biol. 301. Thompson, Main.
Seiwell, H. R. invest. oceano. 210. (Atlantis).
Soule, F. M. sen. phys. oceano. U. S. coast guard. 307.
Stauffer, R. C. grad. phys. Harvard. 101. Cowey, School.
Stetson, H. C. res. assoc. palaeont. Harvard. 213. (Falmouth).
Toth, L. A. instr. phys. Tulane. 303. Bosworth, North.
Vartiovaara, U. privat-docent. Biochem. Inst. Helsinsci. 203. (July).
Waksman, S. A. prof. microbiol. Rutgers. 203. A 101.
Waterman, T. H. teach. fel. biol. Harvard. 413. Cowey, School.
Watson, E. E. asst. prof. physics. Queen's (Ontario). 315. Wilson, Leslie.
Woodcock, A. res. asst. Atlantis. 207.

THE WOODS HOLE CONFERENCE ON AGING

The "Woods Hole Conference on the Problem of Aging," was held at the Cape Codder Hotel on June 25 and 26 with Dr. E. V. Cowdry as chairman. He pointed out that "aging is at the present time our greatest and most neglected human problem." The increase in average age of the population due to lengthening of life, together with decreased employment, have evoked ramifications of this problem which call for the contributions of actuaries, biologists, chemists, sociologists, psychologists and medical men in their solution. The Woods Hole conference was more or less an exploration of the interrelationships of these various approaches. Those attending were Drs. A. J. Carlson, Alfred E. Cohn, E. V. Cowdry, William Crocker, Louis I. Dublin, E. T. Engle, Lawrence K. Frank, Jonas S. Friedenwald, Alfred Friedlander, W. S. Hunter, H. S. Jennings, E. B. Krumbhaar, C. M. McCay, Wm deB. MacNider, E. D. Merrill, Walter R. Miles, Jean Oliver, F. Fremont-Smith, T. Wingate Todd and Clark Wissler.

The Conference was sponsored by the Union of American Biological Societies with the cooperation of divisions of the National Research Council; its expenses were defrayed by the Josiah Macy, Jr. Foundation.

CHILDREN'S SCIENCE SCHOOL OPENS TWENTY-THIRD SEASON

On Monday, June 28th, the Children's School of Science and Junior Laboratory opened its twenty-third season. This year the school is under the direction of Dr. Allan C. Scott of Union College. The staff in addition includes Miss Virginia Mayo of Dana Hall School and Mr. Alfred Compton of Yale University.

There are six courses planned for children ranging in age from seven to sixteen years. These include Introduction to Nature Study for the youngest group, Water Life, Insects, Animals and Plants of Woods Hole, Elementary Biology, and Biological Methods. Among the varied activities are field trips, preparation of collections and laboratory experiments.

The School was originally organized and is maintained by mothers of children attending the School and by the generous support of many interested friends. Located in the scientific center of Woods Hole, it has for many years served as a natural outlet for the interest of children in the community and has given an introduction to nature under able supervision.

The executive committee of the Association in charge of the School is composed of the following persons: *President,* Mrs. H. W. Stunkard; *vice-president,* Mrs. James Mavor; *secretary,* Mrs. Alfred C. Redfield; *treasurer,* Mrs. R. P. Bigelow; *science committee,* Mrs. E. V. Cowdry; *membership committee,* Mrs. Edward Norman; *hygiene committee,* Mrs. J. J. Bronfenbrenner; *scholarship committee,* Mrs. A. P. Clough.

Any member of the executive committee will be glad to give information and advice. Registrations in the School will be accepted during the first week.

TORPEDO RAY RINGS BELL

Amid a carnival atmosphere in the Fisheries hatchery on Monday afternoon, June 28, before a distinguished physiologically-inclined audience somewhat diluted by reporters and dampened by splashed sea water, a much-publicized torpedo ray (electric) was charged with the ultimately myotomic task of "ringing the bell." The manual encouragement of Dr. Prosser brought victory out of potentiality, a tiny tinkle from the electric bell and cheers from the multitude. After soundly discharging this capricious duty handicapped by blindness due to its disguise as a sandwich between two crusts of iron, the animal certainly deserved the familiar prize for such a performance, a "big black cigar." However, it was deemed humane to withhold the award when the animal was found incapable of lighting anything, particularly a small electric bulb.

For the scientifically inquisitive, a sketch of the intimate procedure, as practiced by Dr. Prosser with the assistance of Dr. Curtis and Mr. Spencer, is of course indicated. Naïvely belying by a slight restlessness its teleological conformation the flattened torpedo was fitfully maintained between two sheets of metal which served as electrodes. To these elements were connected successively an electric bell, an automobile bulb, a string of spectators, a loudspeaker and a cathode ray oscillograph.

The electrodes being in contact with the undulating surfaces of the visiting performer and in circuit with the bell, Dr. Prosser seized the tail and surprised the animal with a vigorous twist. In rapid succession, the torpedo jumped, Dr. Prosser jumped, and the bell rang, as the first party quickly and impartially distributed approximately twenty-five volts between the other two. The same procedure, with frequent relief in the arduous task of twisting, evoked darkness from the light bulb, squeals from the serried spectators, silence from the speaker and a beautiful demonstration of the potential from Dr. Curtis' oscillograph, for a high early season batting average of 600.—*C. P. K.*

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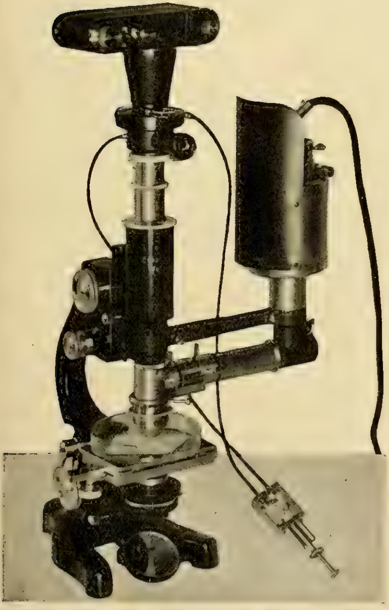

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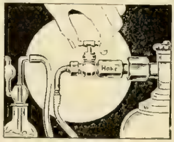

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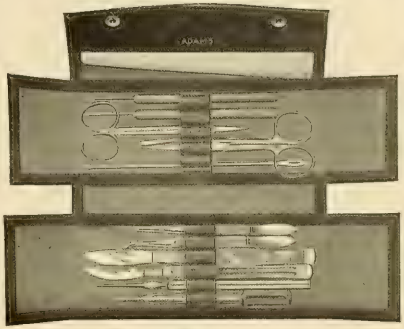

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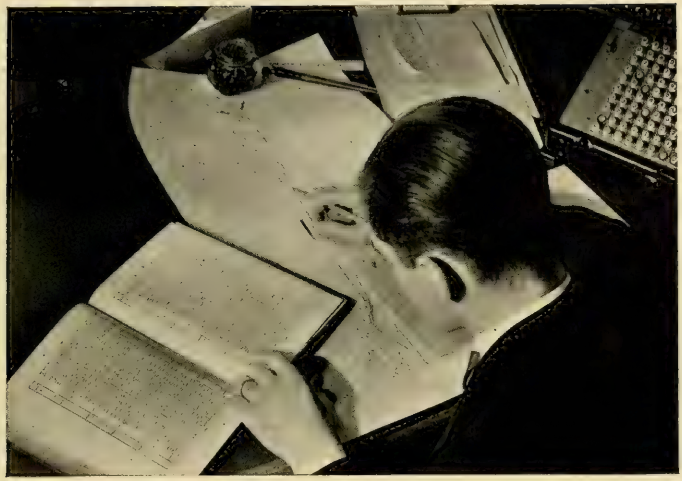

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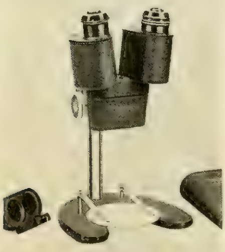

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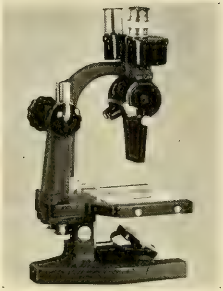

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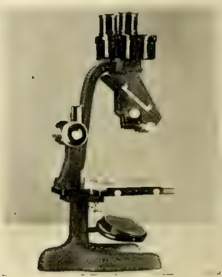

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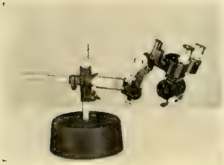

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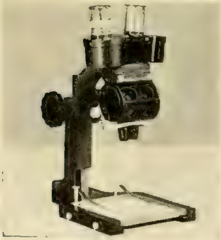

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SUMMER PLANS OF MOUNT DESERT ISLAND BIOLOGICAL LABORATORY

Dr. Earl O. Butcher
Acting Director of the Laboratory

This Laboratory, founded by Dr. J. S. Kingsley in 1898 at South Harpswell, Maine, was moved to Salsbury Cove, on Mt. Desert Island, in 1921. At the present location unusual collecting opportunities are afforded by the different types of sea bottoms, easily accessible coves and bays which contain a very rich collection of animals and plants, typical of the Gulf of Maine.

This is the 39th season that the Laboratory has offered its facilities to the biologists of the world. The number of investigators has increased this year until all available space is nearly filled.

The Laboratory will greatly miss the services of Dr. William H. Cole, director, who is on leave of absence while travelling in Great Britain and Scandinavia. In his place, Dr. Earl O. Butcher of Hamilton College is acting director.

A partial list of the investigators and their research programs available at this time is: Dr. and Mrs. Warren H. Lewis, Carnegie Institution, "Tissue cultures of the hypo- (*Continued on page 36*)

M. B. L. Calendar

TUESDAY, July 13, 8:00 P. M.

Seminar: Dr. Warren Andrew: "Effects of Fatigue Due to Muscular Exercise on the Purkinje Cells of the Cerebellum of Mice at Various Ages."

Mr. Zareh Hadidian, Milton S. Dunn, and Dr. Roland Walker: "Localization in the Oculomotor Nuclei of the Goldfish."

Dr. Ernst Scharrer: "Some New Observations on the Secretory Activity of Neurons."

Dr. C. Ladd Prosser: "Synaptic Transmisson in the Sixth Abdominal Ganglion of the Crayfish."

FRIDAY, July 16, 8:00 P. M.

Lecture: Dr. Alexander Hollaender: "Studies in the Problem of Mitogenetic Radiation."

THE DEVELOPMENT OF INHERITED COLOR PATTERNS IN FISH

Dr. H. B. Goodrich
Professor of Biology, Wesleyan University

This lecture presents a review of investigations carried on for some years in the field of mendelian embryology. The characters selected have been the color patterns of fish upon which genetic analyses have been made. There have been included studies on the development of the color patterns in fish of which the genetics is unknown.

The first type studied was the Japanese freshwater fish *Oryzias* (Haplocheilus) *latipes*. The mendelian varieties concerned are those controlled by a series of multiple allelomorphs, designated B, B′, b and producing respectively a uniform distribution of black pigmentation, an irregular variegated pattern and the apparently complete absence of the black color. Microscopic examinations aided by use of adrenalin to concentrate pigment in cells and so make them visible have shown that the three genetic color phases are produced in all cases by an equal complement of melanophores. In the variegated and light phases, however, the light color areas are occu-

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MEMBERS OF THE WOODS HOLE CONFERENCE ON AGING

Which convened at the Cape Codder Hotel on June 25 and 26, under the chairmanship of Dr. Cowdry. Standing, left to right: Dr. Jean Oliver, Professor of Pathology, Stanford University Medical School; Dr. Walter R. Miles, Professor of Psychology, Yale University; Dr. C. M. McCay, Assistant Professor of Animal Husbandry, Cornell University; Dr. A. J. Carlson, Professor of Physiology, University of Chicago; Dr. F. Fremont-Smith, Medical Director, Josiah Macy Jr. Foundation; Dr. Earl Theron Engle, Associate Professor of Anatomy, College of Physicians and Surgeons; Dr. Lawrence K. Frank, Assistant to the President, Josiah Macy Jr. Foundation; Dr. Jonas S. Friedenwald, Associate Professor of Clinical Ophthalmology, Johns Hopkins Medical School; Dr. Clark Wissler, Curator of Anthropology, American Museum of Natural History; Dr. T. Wingate Todd, Professor of Anatomy, Western Reserve University School of Medicine; Dr. Wm. de B. MacNider, Kenan Research Professor of Pharmacology, University of North Carolina; Dr. Alfred E. Cohn, Member, Rockefeller Institute; Dr. Alfred Friedlander, Dean School of Medicine, University of Cincinnati; Dr. Louis I. Dublin, Third Vice-President and Statistician, Metropolitan Life Insurance Company. Sitting, left to right: Dr. H. S. Jennings, Professor of Zoology, The Johns Hopkins University; Dr. W. S. Hunter, Professor of Genetic Psychology, Clark University; Dr. Elmer D. Merrill, Administrator of Botanical Collections, Harvard University; Dr. E. V. Cowdry, Professor of Cytology, School of Medicine, Washington University, St. Louis; Dr. E. B. Krumbhaar, Professor of Pathology, School of Medicine, University of Pennsylvania; Dr. William Crocker, Director, Boyce-Thompson Institute for Plant Research.

pied by melanophores carrying so little melanin that they often pass unnoticed unless special methods are used. By use of the "Dopa" reaction it can be shown that these "colorless" melanophores possess the oxydase but lack the chromogen necessary for the formation of the normal amount of melanin. It therefore requires the presence of the dominant gene B to bring about the production of the melanin characteristic of the wild type and the genes B′ and b control the production in a descending series of quantitatively less melanin. It is suggested that the extremely irregularly variegated pattern may be explained by the random amoeboid migration of melanoblasts from some source of origin such as the intermediate cell mass.

The above explanation of the light phase of Oryzias raises the question as to whether absence of color in other fish may be similarly explained. In the Paradise fish (*Macroprodus opercularis*), however, it is found that in the albino, a medelian recessive, that the melanophores are entirely lacking. It is possible that the albinotic condition of animals may be a classification which at present includes a number of histologically different conditions.

In the gold fish, *Carassius auratus*, it has been shown that the common gold fish originates as a dark form in which later the melanophores disintegrate leaving the erythrophores (red chromatophores) and these in turn may suffer partial or complete destruction giving the gold and silver or the silver phase. Chen and Schmidt have shown that a form known as the transparent shubunkin when crossed with the ordinary gold fish produces the "calicoe shubunkin"—an irregularly spotted type. Studies on the early (posthatching) stages of these three types have shown that in the ordinary gold fish there is for the first few weeks a steady increase in production of melanophores. In the transparent shubunkin melanophores start to appear at the same rate but after a week begin to disintegrate producing the colorless type. In the hybrid there seems to be a condition of unbalance existing between the opposing tendencies of melanophore multiplication and destruction yielding very variable results in different individuals.

Tissue transplantation by exchanging scales between the different types of gold fish was tried in the hope that this method might be useful in analysing physiological conditions controling the development of the different color phases. This proved impractical on account of tissue antagonism and resulting inflamation. Autotransplants could however be made on the calicoe fish. It was found that melanophores could live and multiply in light as well as dark colored parts of the fish. Scales may also be transplanted in an ordinary gold and black gold fish from a black to a gold area and in the gold and silver fish, gold scales have been transplanted to the silver area and arranged to form a living monogram!

The fish so far mentioned are characterized by variable and irregular patterns. It was desired to study forms having more precise and uniform patterns. Unfortunately few such types are known to show mendelian variations and also the pattern frequently lies beneath the scales preventing the use of the scale transplantation technique. The first fish of such a type studied was the zebra fish (*Brachydaneo serio*). In this case the normal development and also the regeneration of the striped fins were studied. In some respects the mode of development of the pattern seemed intermediate between the conditions described in Oryzias and in Carassius. The area was first entirely covered with a sparce population of melanophores soon concentrating in the region of the future dark stripes and apparently disintegrating in the location of the developing white stripes.

The search for material suitable for tissue transplantation lead to the study of tropical marine coral reef fish. Fishes from the family of Wrasses proved most suitable and such forms were studied both at the Tortugas Laboratory of the Carnegie Institution and at the Marine Station of the University of Hawaii. In both places transplantation experiments were carried out on species having longitudinal stripes and on others having vertical color zones. In the first group the 'slippery dick' (*Halichaeres bivittatus*) of Tortugas and *Julis eudoxi* of Hawaii were used. In both of these cases scales transplanted to a stripe of different color assumed the color of the new location in about twenty days. On the other hand in the case of those having vertical color zones (the bluehead, *Thalassoma bifasciatum*, of Tortugas and the Hinalea lauwili *Thalassoma duperry*, of Hawaii) the transplanted scale retained its original coloration during the duration of the experiment which was about five weeks. It is not known whether this disparity of result is due to a fundamental difference between the two types or merely to a difference in the normal length of life of the chromatophores.

Studies of the cell population of the various pigmented areas of a color pattern is often interesting. As an example may be cited *Thalassoma duperry*. This fish has a blue head region followed posteriorly by an orange zone and the final two-thirds of the body is green with a vertical penciling of red. In the head region there is a deep layer containing melanophores, iridiocytes and erythrophores and superficial to this are islands of melanophores and iridiocytes. Counts in the yellow and green areas gave the following estimates of numbers of chromatophores per square millimeter.

	Yellow Zone	Green Zone
Melanophores	271	596
Xanthophores	1057	527
Iridiocytes	3300	3300
	4628	4423

The diversity of results obtained shows that almost all fish so far investigated have their own distinctive mechanism of color pattern formation.

Other fish which have been the subject of genetic investigation may well also be suitable for such developmental studies. Among such may be mentioned *Platypoecilus maculatus* investigated by Gordon and others. In this fish the large melanophores seem to be controlled by one gene and the small ones by another gene. The ubiquitous Guppy (*Lebestes reticulatus*), by which the genetic analysis was made by Winge, is especially suggestive as suitable for further studies. Various colored spots seem to be controlled by different genes, there exists sex dimorphism and sex reversal is also reported. So far however investigation into the nature of the controling mechanisms have yielded negative results.

The conditions in fish may be contrasted with those in other forms. For example may be cited the striping in birds so notably investigated at the University of Chicago under Dr. Frank Lillie. In this case the marking of feathers is controlled by the discharge of hormones which, acting upon a feather germ, control the development of pigment. Once however the pigment is fabricated it is removed from any further hormone influence on the outgrowing feathers. It seems impossible to invoke this type of mechanism to explain striping in such animals as a fish or a zebra.

(This article is based upon an evening lecture presented at the Marine Biological Laboratory on July 2).

SUMMER PLANS OF MOUNT DESERT ISLAND BIOLOGICAL LABORATORY

(Continued from page 33)

physis and cancerous tissues"; Dr. J. Wendell Burger, Trinity College, "The eggs and spermatozoa of marine snails"; Dr. Earl O. Butcher, Hamilton College, "The structure of the eye of Fundulus and its relation to adaptation"; Dr. Ulric Dahlgren and Mr. Edward Chambers, Princeton University, "Microdissection studies of the tracheal end organs of fire flies"; Mr. R. C. Grenell, New York University, "Embryology of the pituitary"; Dr. J. T. Halsey, Tulane University, "The blood pressure of fishes as related to certain drugs"; Dr. Libbie Hyman, American Museum of Natural History, "Studies on jellyfish and other related animals"; Dr. E. K. Marshall, Jr., and assistant, John Litchfield, Johns Hopkins, "Excretion and changes of sulfanilamide in fishes"; Mr. Samuel Miles, Johns Hopkins Medical School, "Studies on hydroids"; Dr. Dwight E. Minnich and assistants, Lloyd Smith and Charles Reif, University of Minnesota, "The behavior of certain invertebrates when stimulated by light and sound"; Dr. Earle B. Perkins, Rutgers University, Zoologist of the Second Byrd Antarctic Expedition, "Motion picture records of marine invertebrates for instructional use in college"; Dr. Homer W. Smith and assistants, Dr. Willie W. Smith, Miss Helen Keigher, and Mr. R. V. Naumann, New York University, "The mechanism of acidification of the urine, and the excretion of bicarbonate and phosphate"; Dr. James A. Shannon and Dr. David M. Korr, New York University, "Studies on kidney function"; Mr. E. L. Young, III, Harvard University, "The wasting disease of eel grass." Dr. Esther F. Byrnes of Philadelphia, Dr. Robert W. Hegner, Johns Hopkins, and others are expected in Salsbury Cove for part of the summer.

As usual during the last few years, the Laboratory will be open for visitors on Wednesday afternoons beginning July 7th. At this time the collectors and Park Naturalist demonstrate animals in the aquaria, and describe their habitats. Visiting days give persons interested in the work of the Laboratory the opportunity of inspecting the facilities and becoming better acquainted with programs of research.

The Laboratory will greatly miss its former vice-president, Dr. Duncan S. Johnson of Johns Hopkins who passed away last January. Since its organization on Mt. Desert Island in 1921, Dr. Johnson had served as trustee and vice-president and had been an active and loyal supporter of the work of the Laboratory.

THE COLLECTING NET has been entered as second-class matter July 11, 1935, at the Post Office at Woods Hole, Massachusetts, under the Act of March 3, 1879. It is devoted to the scientific work at marine biological laboratories. It is published weekly for ten weeks between June 1 and September 15 from Woods Hole and printed at The Darwin Press, New Bedford. Its editorial offices are situated on the third floor of the Woods Hole station of the United States Bureau of Fisheries. Between June 1 and October 1 communications should be addressed to Woods Hole, Massachusetts; at other times they should be directed to THE COLLECTING NET, Garrison, N. Y. Single copies cost 30c; a subscription (containing not less than 280 pages) costs $2.00.

SOME OXIDATIVE PROPERTIES OF ISOLATED AMPHIBIAN GERMINAL VESICLES

Dr. Jean Brachet
Chargé de Cours à l'Université de Bruxelles

It is a relatively easy task to take the germinal vesicle out of the largest oöcytes in amphibian and fish eggs; this enables us to study the properties of the nucleus during the oögenesis and to throw some light on its physicochemical composition and its function. It was of interest to start such an investigation with a study of the oxidative properties of the isolated germinal vesicle since very divergent opinions have been held concerning the possible functions of the nucleus in respiration.

Using sufficiently sensitive devices, it is possible to measure the oxygen consumption and the carbon dioxide elimination of isolated amphibian germinal vesicles and compare these values with the metabolic rate of an intact oöcyte: such an investigation showed that the nuclei display a small, but constant (at least during several hours) respiration: the rate of oxidation in the isolated nuclei is definitely lower than it is in the whole oöcyte and it may be stated that the oxygen consumption of one single isolated nucleus represents only 1 to 1.5% of the respiration of the oöcyte. This is further supported by the fact that an oöcyte, the nucleus of which has been removed and is then allowed to heal still keeps its CO_2 elimination at approximately the same level.

Furthermore, it could be shown that the addition to the nuclei of glucose or of cytoplasm removed by means of a micropipette from an oöcyte does not enhance the respiration of the isolated germinal vesicle. Likewise, the presence or the absence of calcium ions, which, according to W. R. Duryee, affect greatly the physical properties of these isolated nuclei, remained without appreciable effect.

These observations make it unlikely that the germinal vesicle must be considered as a centre of high respiratory metabolism, although the oöcyte's nucleus must be important in other respects.

(This article is based on a seminar report given at The Marine Biological Laboratory on July 6).

PARTHENOGENETIC MEROGONY IN NAPLES SEA URCHINS

Dr. Ethel Browne Harvey
Independent Investigator, Princeton University

The term parthenogenetic merogony is applied to the development of non-nucleate parts of eggs which are artificially activated; that is, development of egg fractions, halves and quarters, without any nucleus whatever, either male or female. The fractions are obtained by breaking apart the eggs by means of centrifugal force. The nucleus is always in the lighter half of the egg, so that the heavier half is non-nucleate. These heavier halves and the quarters into which they break are treated with parthenogenetic agents, such as hypertonic sea water.

I have previously reported and published my results with *Arbacia punctulata*. In brief, fertilization membranes are formed, then there is a large monaster, then an amphiaster and the eggs often cleave between the two asters. Cleavage follows upon cleavage until a blastula is formed of some 500 cells; the organism breaks through the fertilization membrane. Some multiastral but non-cellular organisms from non-nucleate eggs have lived for four weeks without further differentiation.

A recent critical examination of prepared slides of the parthenogenetic merogones of *Arbacia punctulata* shows the presence of asters, usually in pairs, but no chromosomes. The Feulgen reaction, in the procedure of which I was assisted by Dr. Brachet, is entirely negative. The parthenogenetic merogones show no red-staining nuclear material, whereas the fertilized merogones which were used as control material, show it very clearly.

There are 4 common species of sea urchins occurring at Naples. In some of these there is no pigment and in some the stratification after centrifuging is such that the mitochondria are in the non-nucleate half. The non-nucleated halves of all the species can be activated by hypertonic sea water.

In *Arbacia pustulosa,* which is similar to the Arbacia at Woods Hole, asters and cleavages occur in the non-nucleate half, when activated, similar to what has been described for *Arbacia punctulata.*

In *Parechinus* (*Echinus*) *microtuberculatus* and *Paracentrotus* (*Strongylocentrotus*) *lividus,* the fertilization membrane in activated non-nucleate halves is well separated from the cell surface, just as in normally fertilized whole eggs of these species. A large monaster is formed, an amphiaster and there are one or two cleavages.

The cleavage planes frequently disappear and sometime afterward the egg breaks up into a number of pieces. These become progressively smaller and more numerous until what resembles a blastula is formed. This breaks through the fertilization membrane, but no further development has been observed. The non-nucleate halves of *Sphaerechinus granularis* can also be activated and they break up into small pieces in a similar way.

It might appear that this breaking up of the egg is a form of degeneration or cytolysis. But the same spontaneous breaking up of the cell has been observed also in normal whole nucleate eggs artificially activated. These sometimes gave rise to typical blastulae which became free swimming and looked normal in every respect.

A point of interest that turned up in connection with this work has been the activation of immature eggs with the germinal vesicle still intact. By treating the immature egg with parthenogenetic agents, there is formed a very definite layer on the periphery of the cell similar to the ectoplasmic layer in the fertilized or activated mature egg. This is formed both on the half containing the germinal vesicle and the heavier half separated from it by centrifugal force. . Another evidence of activation is the failure to respond to sperm. It has long been known that whenever the sperm touch the normal immature egg, a sort of blister is formed. These blisters do not form if sperm are added to the treated immature eggs. The treated immature egg, after some time, pinches off a small piece, always at the part most distant from the germinal vesicle in elongated eggs. Later there are two, three or more pieces and then a great number. I do not claim that this is cleavage in the true sense, but there is certainly some change, at least in the cortex, caused by parthenogenetic agents, in the immature egg similar to what occurs in the mature egg.

The paper was accompanied by photographs of the living eggs, many of them consecutive photographs of the same egg.

(This article is based upon a seminar report given at The Marine Biological Laboratory on July 6).

INFLUENCE OF TEMPERATURE AND OTHER AGENTS ON THE RESPIRATION AND DEVELOPMENT OF MARINE EGGS

DR. ALBERT TYLER

Instructor in Embryology, California Institute of Technology

In attempting to determine the reactions that underlie the various changes that a developing egg undergoes, it is as important for the embryologist to know something about the energy changes as it is for the physiologist in the study of muscular contraction. In the developing embryo, it was necessary to show that energy is actually required for differentiation, since this has been seriously doubted. An embryo exhibits, in addition to differentiation, two other main processes called growth and maintenance, and the energy turnover might be concerned only with one or both of the latter. To decide this point we would want to produce embryos in which one of these is eliminated or varied without the others being affected. It is possible to produce embryos that should have an increased requirement for differentiation while maintenance and growth remain constant. These are simply the dwarf embryos that one gets by isolating the two cells of the two-cell stage of an egg such as that of the sea-urchin. Since the total amount of living material is not changed by separating the two cells, the two dwarf embryos should have the same maintenance and growth requirements as one whole embryo. The requirements for differentiation should, however, be greater. This expectation is based on the principle of similitudes, which physicists employ in model experiments and which can be used here since the dwarf embryo is a small model of the whole embryo. Assuming that the respiration is a measure of the energy turnover of an embryo, we should expect an increase on the part of the dwarfs. The measurements show that this is the case. We do not, however, have an increase in rate of oxygen consumption. What happens is that the dwarf embryos develop more slowly and respire at the same rate as the normals. So, to reach the same stage of development, two dwarf embryos consume more oxygen than one whole embryo. (*Pubbl. Staz. Zool. Napoli, 13,* 155, 1933).

The slower development of embryos from isolated blastomeres has often been noted in the literature and generally interpreted as being due to the mysterious process called regulation; quarter and one-eighth embryos which develop still slower, presumably having to undergo more regulation. Now, if giant embryos are produced from the fusion of two eggs, they should undergo as much regulation as the dwarf embryos and should therefore develop more slowly than normal. The experiments, however show that they develop more rapidly than normal, which conforms to the expectation from the present analysis. (*Biol. Bull., 68,* 451, 1935).

The processes of differentiation, growth and maintenance might conceivably be differently affected by change in temperature. But experiments designed to test this point showed that this is unlikely, at least for the early stages of development of marine eggs. Temperature affects the rate of development and the rate of respiration in the same way. If the rate of respiration is tripled by a 10° rise in temperature, the rate of development is also tripled. Regardless of the temperature, within the normal range, an embryo will consume the same amount of oxygen in reaching a given stage of development. There is no optimum temperature at which development is accomplished with a minimum respiration. Unless there are some complicated compensatory effects, the three developmental processes may be taken to have the same temperature coefficients. (*Biol. Bull., 71,* 59, 1936).

Now an unfertilized egg presumably exhibits simply maintenance. It is merely concerned with keeping itself alive. We might, therefore, expect the respiration of the unfertilized egg to have the same temperature coefficient as that of the fertilized egg. Such an investigation was made by Rubenstein and Gerard (1934) on eggs of Arbacia. They obtained average Q_{10} values of 4.1 for unfertilized and 1.8 for fertilized eggs. From this they make the interesting calculation that at 32°C. the classical rise in respiratory rate of the echinoderm egg would disappear. Their data show, however, a number of errors of calculation and surprisingly small readings, which make their conclusion less convincing. A re-investigation of this question on eggs of the west coast sea-urchin, Strongylocentrotus and three other forms, Dendraster, Urechis and Ciona, gave no such striking differences in the Q_{10}'s. At the upper part of the temperature scale there are no significant differences; the average Q_{10} values for unfertilized eggs for the temperatures 22° and 12° being 2.54 and 2.36 in Strongylocentrotus; 2.65 and 2.80 in Dendraster; 2.57 and 2.65 in Urechis; 1.97 and 2.49 in Ciona. At the lower temperatures there may be significant differences since the fertilized eggs give consistently higher values in all four forms. The determinations are complicated by the fact that unfertilized eggs do not maintain a constant rate of respiration, but the rate rises with time. This rise is itself of some interest. The eggs of Strongylocentrotus and Dendraster which show a relatively rapid rise have a considerably shorter fertilizable life than do the eggs of Urechis and Ciona in which the rise is much slower. The rise in respiratory rate, thus, appears to be correlated with the loss of fertilizability.

The temperature coefficient determinations were designed to take into account this rise whenever it became a significant factor. If the differences in Q_{10} at the lower temperatures are significant, then one of the original assumptions, on which was based the expectation of identical Q_{10}'s for fertilized and unfertilized eggs, must be wrong. This is possibly the assumption that an unfertilized egg is a "resting cell" exhibiting only maintenance.

A question that arises in this work is whether it is possible to speed up the rate of development, above that attained at the highest temperatures that an egg will stand. Speeding up the rate of respiration would only be expected to do this if the respiration were concerned in some initial rather than a recovery reaction, and if the increased respiration passed through the normal respiratory system of the cell. On the other hand, agents that lower the respiratory rate should cause a corresponding retardation in developmental rate (where development is normal) provided that any oxygen debt, that may occur, is taken into account. This is because we consider the depressed respiration to be still part of the normal respiratory system of the cell. It has long been known that cyanide, for example, will slow up the rate of respiration; also that it will retard development. But whether the retardation is the same for both has not been determined. Actually it is difficult to get satisfactory results with cyanide. The eggs cannot be slowed up more than about 30% without permanent injury. Also the alkali in the respiration vessel removes the cyanide. In one experiment, of several that were run, 3 hours development in cyanide corresponded to 2 hours normal development. The total respiration was approximately the same in the treated and the controls. Another agent, sodium azide, that was tried gave similar results. More experiments with more suitable agents are needed to decide the points at issue.

(This article is based on a seminar report given at the Marine Biological Laboratory on July 6).

CHANGES IN THE CELLS OF THE ADRENAL CORTEX OF THE EWE DURING ESTRUS AND PREGNANCY

Dr. Laura J. Nahm

Professor of Biology, Junior College, Flat River, Missouri

A physiological relationship between the adrenal cortex and the changes occurring during the estrous cycle and pregnancy has long been believed to exist. However, experiments which were designed to determine whether such a relationship actually occurs have produced conflicting results. If adrenal cortical cells produce an increased amount of secretion during estrus or pregnancy, simultaneous morphological changes in the cells of the gland might be expected to occur. The present study was undertaken from such a morphological point of view to determine whether variations in cell types and cell contents actually occurred and, if so, what their nature might be.

The adrenal glands used were taken from ewes killed by Dr. F. F. McKenzie and his collaborators of the Animal Husbandry Department of the University of Missouri during their experiments on the physiology of reproduction. These animals represented 13 different stages of estrous cycle, and 32 different stages of pregnancy. Fixation methods used were those of Champy, Helly, Bouin, and Nassonov. Sections were stained with aniline acid fuchsin counterstained with thionin or methyl green and with iron haematoxylin and orange G.

These principal types of changes were apparent in the cells. These were (1) variations in the proportions of light and dark cells (2) variations in the liquid content of the cells and (3) variations in the number of chondriosomes.

The number of dark cells increased gradually from proestrum through estrus and decreased during metestrum and early diestrum. In later diestrum and early proestrum, a rise was again apparent. The estrous level was maintained during early pregnancy but was reduced gradually between the twelfth and the thirty-sixth day. The proportion of dark cells had then reached the low level of early diestrum and remained so until the eighty-fourth day. After that time a gradual rise began and continued until parturition, at which time the cells showed a greater variation of staining reaction and topography than ever before. In addition to the cells which stained dark red with fuchsin, others were orange or purple. Many were vacuolated.

Changes in the amount of lipoid paralleled those of dark cells. The amount of lipoid was high during estrus, decreased in metestrum, and increased in proestrum. Lipoid spheres were more conspicuous during pregnancy than during the estrous cycle. From the first to the fourth day of pregnancy, the amount fell somewhat below the estrous level, then rose gradually until the twenty-fourth day, dropped off again until the thirty-sixth day, and then rose gradually till the 136th day. At the latter stage, the amount of lipoid exceeded that found at any other time. At parturition the lipoid spheres were very large, but the total amount present was reduced slightly. Lipoid was most abundant in the zona glomerulosa.

The number of chondriosomes was largest in early estrus, dropped off after one day, and fluctuated at a somewhat lower level until the sixth day, after which it remained low until proestrum when a rise again occurred. Throughout the gestation period the number of chondriosomes fluctuated considerably showing sharp rises and falls until the twenty-fourth day. During later pregnancy the number rose gradually until the 136th day and from that point until parturition was somewhat reduced.

Two other cell constituents were noted but materials for a complete study were lacking. The Golgi bodies were observed in cells of the zona fasciculata after osmication for ten days according to the method of Nassonov. They consisted of slender blackened filaments which formed a net adjacent to the nucleus. Lipoid spheres in all the cortical cells were intensely osmicated and retained their color after bleaching with turpentine. Small fuchsin-stained spheres resembling nucleoli in size and general appearance were observed in many cells in all regions of the adrenal cortex.

The relation of the adrenal gland to the estrous cycle and pregnancy is still a subject of controversy. Lewis (1923) found that 60 to 80% of the rats he used survived bilateral adrenalectomy and reproductive functions and pregnancy appeared normal. Schiffer and Nice (1930) observed only a very slight lengthening of the estrous cycle following removal of the adrenal glands. On the other hand, when Wyman (1928) performed similar experiments, 70 to 82% of the animals died and in those which survived, the estrous cycle was inhibited or prolonged. Martin (1932) confirmed Wyman's results.

Other investigators have observed the adrenal glands. Andersen and Kennedy (1932 and 1933) found that the cortex of the adrenal gland of the rat increased in size during estrus and the cells contained an increased amount of lipoid. Foster (1934) and Zalesky (1934) observed decided increases in size, weight and vascularity of the adrenal gland of the thirteen-lined ground squirrel during the breeding season.

The cyclical nature of the changes which have just been described suggest a relationship between the cells of the adrenal cortex and the estrus cycle and pregnancy in the ewe. Hoerr (1931) considered the differentiation into light and dark cells as the first step in their degeneration. The increased number of dark cells during estrus, early pregnancy and late pregnancy suggest that the gland has recently released secretion products and the cells have begun to degenerate. This is particularly true at the end of the gestation period when the cells appear to be completely exhausted.

The significance of large amounts of lipoid in the cells has been variously interpreted. Zwemer (1936) found that the "lipoid storage type of gland might be produced as a result of rather mild stimulation." He interpreted the lipoid as either the raw material from which the secretion was made or the vehicle in which it was stored. If lipoid is utilized in the production of secretion, the gradual increase up to the time of early estrus and its diminution immediately thereafter would be expected. The larger amount of lipoid present during pregnancy and its diminution immediately after parturition would also be in line with the expected results.

The more frequent fluctions in the number of chondriosomes seems to indicate that they are more transitory structures which may be readily converted.

Results which have been described are based on rather small samples of the gland. Fixation seemed to be thorough in only a rather limited portion of each section. In spite of these difficulties, however, the results do seem to justify the conclusion that cyclical changes do occur in the cells of the adrenal cortex of the ewe during the estrous cycle and pregnancy.

(This article is based upon a seminar report given at the Marine Biological Laboratory on August 11, 1936).

NOTES AND NEWS FROM M. B. L. CLASSES

PHYSIOLOGY CLASS NOTES

Inasmuch as firecrackers are giving a good imitation of the World War outside, this account may prove a trifle jerky, but we'll do the best we can.

We've had lectures from Dr. Fisher this week on chemical changes associated with the liberation of energy in the cell and these brought us again to Warburg's "atmungsferment." Dr. Irving told us about the composition of salts of the ocean and whence they came and about adjustments of respiratory and vascular systems in diving animals. Most of us have since haunted the Bureau of Fisheries pool timing the seals as they lie on their float with their heads hanging over and their noses under water.

Anyone passing the physiology lab during the last few days may have heard some unusually strongly seasoned language as students of Dr. and Mrs. Höber struggled valiantly to put big cannulas in the not so big ureters of a frog—and not one cannula but two cannulas! One might be achieved after great strain on patience and humor, but the second cannula invariably knocked out the first and we finally decided that no one can be an expert perfusionist like Dr. Höber unless he is an amateur magician and can really put a camel through the needle's eye.

Dr. Irving has had people working on Van Slyke and Haldane CO_2 determinations. The most striking results of these were much mercury on the floor and the general impression that there are more ways of breaking $50 worth of apparatus than there are quills on a porcupine.

Dr. Sichel's work on micromanipulation continues and the Warburg apparatus still gets its daily workout. Dr. Prosser is free in theory but he and Mrs. Prosser are in lab every day killing frogs and clams for the cause of science.

The Americanization of Dr. Ohnell continues. He has mastered the American art of mass production by quadrupling his set-up for observing Fundulus hearts and achieving the record count of 15 fish in 5 minutes. The Fourth of July has also had its effect on the gentleman from Sweden. Dr. Ohnell found out how to shoot fire crackers but the fire crackers wouldn't oblige, probably because they had "patent pending" on the wrapper.

The rest of us made the most of the Fourth in varied fashions, picnics and boat rides being the favorite. Now we are all looking forward to a week from Wednesday when the whole physiology course, staff and students, will have their annual celebration. —*M. H.*

PROTOZOOLOGY CLASS NOTES

An illustrated preview of "what it is all about" was presented to the class in protozoology when Dr. Calkins tripped lightly through the four main groups of one celled animals in four easy (for Einstein) lessons. While the students were still gasping for air they were learning with joy that identifying and drawing protozoa is a sport of kings—difficult but soul satisfying. It was, the first week-end, of particular enlightenment to the ego to learn that one is expected to draw with a beauty and accuracy unequalled by the most eminent protozoologists of the past. Now, after two weeks, some in our number have been industrious enough to feel that eventually they may progress one or two micra toward mastery.

June 29th, Dr. Kidder lectured on early conception of protozoa and the cell theory. We heard, with interest, of the theory of Ehrenberg in 1838, who, like Leeuwenhoek, looked on "infusion animals" as complete organisms containing nerves, muscles and complete alimentary canals. In spite of the work of Dujardin in 1841 it was many years before these forms were accepted as one celled animals and plants. Dr. Kidder reviewed the literature concerned through the comparatively recent investigations of Koehring, Cosmovici, and Hall and Alvey on the possibility of food vacuoles in Ciliates being connected by canals.

The theory of Dobell, who feels that the term "cell" should not be applied to our so called protozoa, gave us much food for further thought and study.

Since the binocular arrived the class has developed gladiator tendencies, the members contesting for the coveted microscope. The students are individualists, and no teams have been formed. Cries are going up for a referee and Dr. Julius Caesar Kidder has been proposed as chief judge of the arena. —*M. H.*

EMBRYOLOGY CLASS NOTES

Last week the embryology class studied the Coelenterates under the direction of Dr. Barth of Columbia. Much time was spent in tying off measured lengths of Tubularia stems, watching the stems regenerate hydranths, and measuring the rate of regeneration. Dr. Goodrich, although no longer lecturing, still keeps his eye on the class. During these experiments on Tubularia he caught Charlotte Gross tying a bit of blue string around Elizabeth Lloyd White's head and wanted to know if that was another experiment on regeneration.

Starting Thursday, Dr. Charles Packard introduced the topics of "Fertilization" and "Cleavage in Annelids and Molluscs." The laboratory work at this point included a study of fertilization and cleavage in the eggs of Nereis, Cumingia, and Chaetopterus and also of the maturation stages and spiral cleavage in stained Crepidula slides. On Saturday Dr. Albert Tyler of the California Institute of Technology spoke on "Production of Twins and Double Monsters in Annelids and Molluscs."

But lest one get the impression that the embryology class is all work and no play, here is a bit of information on how embryologists spend their "spare" time. One day a group visited the Coast Guard Cutter and were conducted all through it, even having the guns, shells, and T. N. T. shown them. Some one asked where the T. N. T. was kept and the sailor pointed to a box on which Billy Bozeman was sitting. The rapidity of Billy's ascent at this news is still being discussed in various circles. The noise that issued from the street last Monday night to the great annoyance of those in the library was the work of several members jumping rope. Quite a crowd gathered to join the fun and traffic had to be re-routed through Center Street. The great and glorious Fourth seems to have been unanimously spent in picnicing. Some hiked to spots, some rode, and some went in boats. The weather cooperated to an unusual extent, and all gathered a goodly supply of sunburn as can be seen by glancing around the "mess." But the prize bit of the week happened when a certain man was looking for a girl to take to Falmouth and Dick Blanc offered his services.

The baseball team has met the Oceanographic team twice but neither side could muster enough players for a real game.

The annual all day excursion for the embryology class has been set for Tuesday, July 13th.

—*B. H. L.*

"ATLANTIS" PROGRAM FOR JUNE AND JULY

During June the "Atlantis" began work on the new project which has been planned in cooperation with the Bermuda Biological Station and a committee of the Royal Society. This program involves a study of the fluctuations in strength of the Gulf Stream during the next five years and also an intensive examination of the effect of the wind on surface movements. It is hoped that through these investigations some progress will be made towards solving the important problem of climatic variations and of fluctuations in the fisheries of the northeastern North Atlantic.

As the new Bermudan boat is not yet ready, the "Atlantis" will undertake during the next six months to secure all the necessary observations. In June a profile consisting of 27 stations was occupied between Montauk Point and Bermuda. This will provide excellent data for determining the volume of the Gulf Stream for this period. Similar sections will be run six or eight times during the next year. Mr. H. R. Seiwell joined the "Atlantis" at Bermuda and during the return voyage carried out further studies on the short period internal waves which produce the main uncertainty in modern hydrodynamic studies of oceanic currents. It is hoped that, as more is known about the various periods of submarine waves, the technique of determining the volume of such a current as the Gulf Stream will be much simplified.

At the present time (July 8-26) the "Atlantis" is again cruising toward Bermuda, but this time the investigations have a more pronounced biological application. At a station representative of the center of circulation of the Sargasso Sea, a complete series of tows will be made with 2 meter closing nets. Thus the population will be thoroughly sampled from surface to bottom in a quantitative manner. At the same time a full series of water samples from frequent depth intervals will be analyzed chemically, the aim being to correlate the density of the population at each level with the chemical changes in the water. Dr. George Clarke is in charge of this work and he is accompanied by a scientific party of five.

The latter part of July will be devoted to a short cruise to enable Dr. Maurice Ewing to carry out preliminary tests in the use of explosives in deep water. His aim is to perfect a technique whereby the methods of seismic geology can be used in the ocean basins to determine the thickness of the unconsolidated sediments. During the summer of 1935 the thickness of the sediments over the continental shelf was successfully measured from the "Atlantis" and it is now hoped that similar observations can soon be carried out in deep water.—*Columbus Iselin.*

DEPARTMENT OF PUBLICATIONS

PROTOPLASM. William Seifriz. x + 584 pp. 179 illustrations. McGraw-Hill Book Co. 1936.

The book deals with "the application of physics and chemistry to those biological phenomena which can be reduced to cellular or protoplasmic processes." It is written for students in biology and in medicine; consequently one cannot expect to find in it the completeness of exposition of the phenomena as they are presented, for example, in Hoeber's "Physikalische Chemie der Zelle und der Gewebe" (latest edition 1926). The treatment of the subject is elementary; not a single symbol of differentiation or integration is to be found in the whole book; fundamental formulae are not derived but merely stated. But what else could the author do, considering the background of the expected users of the book? "Man muss die Feste feiern wie sie fallen!"

The twenty-seven chapters deal with the following topics: the living substance, the cell, model making (R. Lillie's iron wire-nerve model, Herrera's imitation of amoebae, Osterhout's and Northrop's artificial cells imitating plasma membrane permeability etc.), micrurgy (micro-dissection, injection, electrodes), tissue culture (full credit given to Harrison), the colloidal state, surface tension, adsorption, osmosis, imbibition, viscosity (two lines for Heilbrunn), elasticity, structure of protoplasm, permeability, acidity (Brönsted's concepts), electrophysiology (electro kinetics, rôle of water, inorganic and organic constituents, regulatory substances (enzymes — two pages, hormones — four pages, vitamins — three pages, 15 lines and one formula for chemical constitution of vitamins, pigments, sulphydryl compounds—5 pages). The closing chapter is on the origin of living matter.

The book reads remarkably well, one feels it was written with gusto. The author has a talent for foreseeing just where the student would likely assimilate a misconception of a term and he prevents that by skillfully developing the term so that its meaning stands out very clearly. He must be an excellent and enthusiastic teacher. In going through the text the more seasoned MBLaborite realizes how much inspiration and knowledge he owes to the reports and lectures to which he was exposed (if he could hear them!) during the summers he spent in Woods Hole. How familiar the topics of the book, the names of the many pioneer workers in the various fields sound to him! But it is also he who will very often be disappointed, feeling full justice was not done to a number of deserving ones of our MBL family. We associate viscosity with Heilbrunn and his cohorts, elasticity of single muscle cells with Sichel, elasticity of eggs with KC (Cole). What about the wizardry of the micrurgeons of the Chambers' group, the centrifuging methods of the Harveys? More could have been said about their work and that of many others of the Woods Hole group, all applying physicochemical methods to the study of protoplasm.

However, taking the book as an initiation of the reader into the field it must be said that it does its work very well indeed. Anyone coming to Woods Hole with this book in his mental equipment will bring along a better understanding of the endeavors of the various workers at the MBLaboratory. E. ALFRED WOLF

THE MIGRATIONS OF ANIMALS FROM SEA TO LAND, by A. S. Pearse. Duke University Press. 1936, 176 pp. $3.00.

For students of ecology this book is a useful guide to literature bearing on the evolution of marine animals into land animals. As for the author's essay and conclusions, however, which are written in the anthropomorphic tone found too frequently in such books, they give the impression that animals had consciously and willfully brought about their evolution, had decided assembled in convention, so to speak, the destiny of their descendents. Thus the book is full of such sentences as "They (animals) have had to give up old racial tradition." As memoirs, such books as this can be entertaining literature. The present work, however, makes such dull reading that it is doubtful anyone will be able to wallow much beyond page six, except, perhaps, college students, who may be so unfortunate as to be required to read it.

L. A. W.

NOTES ON THE ACTIVITIES OF THE M. B. L. CLUB

The activities of the club now extend to chess, with a number of dubs and kibitzers and at least one expert. Ping-pong resounds through the house daily, with wiring for new lights for the ping-pong table under way. The floor has had a coating of wax substituted for last week's coating of sand.

The chamber music series has been changed to Wednesday nights to avoid conflicts with the rehearsals of the choral club. The attendance has been about 70 at the two chamber music concerts and nearly 100 at the Monday symphony concerts. Monday, July 12, the music committee will present the Piano Concerto of Tschaikowsky, the 4th Symphony of Sibelius, and the 7th Symphony of Beethoven. On Wednesday, July 14, the Kreutzer Sonata of Beethoven and Bach's Suite No. 2 in B minor for flute and strings will be presented.

The membership is growing rapidly and the support of all old and new members is needed to finance repairs and expand the activities of the club.

—A. B. C.

The Collecting Net

A weekly publication devoted to the scientific work at marine biological laboratories

Edited by Ware Cattell with the assistance of C. P. Kraatz, Anna-Betty Clark, A. S. Cattell and Mary Goffin.

Entered as second-class matter July 11, 1935, at the U. S. Post Office at Woods Hole, Massachusetts, under the Act of March 3, 1879.

AN INTERESTING SUGGESTION

The increasing usefulness of The Collecting Net has brought about the suggestion that members of the corporation of the Marine Biological Laboratory be given the opportunity of substituting this journal for *The Biological Bulletin* which they now receive as part of their membership. There is precedent for an arrangement of this kind; for example, members of the American Association for the Advancement of Science may substitute *The Scientific Monthly* for *Science* although the latter is the official journal of the Association.

The Laboratory would benefit if every member of the corporation read The Collecting Net; it provides a weekly report of Laboratory affairs during the active season. In the last analysis the members of the corporation are responsible for Laboratory policies; through the weekly journal they could become more intimately acquainted with the local problems of the Institution, thereby increasing their administrative efficiency.

Should the proposal meet with approval, and the Laboratory require season subscriptions in quantity it might be possible to supply the journal at the reduced rate of $1.00. It would, of course, be desirable for each member of the corporation to receive both journals; this might be made feasable by advancing the annual assessment from $6.00 to $7.00.

In response to our request for the use of the Auditorium of the Marine Biological Laboratory for the purposes of the Biological Scholarship Association the secretary of the Executive Committee writes:

> The Executive Committee has discussed the question of the use of the Auditorium and considering the rapidly increasing number of demands upon its use, has made the following regulation: "That the use of the auditorium during July and August be restricted to the official or scientific purposes of the Corporation."
>
> The committee has instructed me to inform you that, under this regulation it is necessary to decline your request for the use of the auditorium.

INVESTIGATORS

Bailey, Gladys H. instr. zool. Hunter. Br 9. D 101A.
Bailey, P. L., Jr. asst. prof. biol. City of New York. Br 9. D 101A.
Ballard, W. W. asst. prof. biol. Dartmouth. OM 45.
Chambers, R. prof. biol. New York. Br 328c. Knight, School.
Churney, L. instr. zool. Pennsylvania. Br 111. Cowey, School.
Corey, H. Irene res. assoc. zool. Pennsylvania. Br 219. D 306.
Dahl, A. O. teach. asst. bot. Minnesota. Bot 1. Young, Middle.
Diller, W. F. asst. biol. Dartmouth. OM 45. Sylvia, School.
Donaldson, H. H. prof. anat. Wistar Inst. Br 115. Buzzards Bay.
Grant, R. trav. fel. zool. Columbia. Bot 2nd. Elliot, Center.
Hadley, C. E. assoc. prof. biol. Montclair State Teachers'. OM 29. D 205.
Hodge, C. asst. prof. biol. Temple. Bot 1. K 10.
Hutchings, Lois M. teach. biol. Weequahic H. S. (Newark, N. J.). Bot 21. White, Main.
Levine, D. S. teach. biol. Theodore Roosevelt H. S. (N. Y.). Bot 1. Smith, East.
Lynn, W. G. instr. zool. Hopkins. Br 217g. Berg, High.
Matthews, S. A. assoc. anat. Pennsylvania. OM 24. D 208-9.
Morrill, C. V. assoc. prof. anat. Cornell Med. Br 310. Cape Codder.
Patrick, Ruth prof. bot. Pennsylvania School of Horticulture. Bot 22. K 10.
Sayles, L. P. asst. prof. zool. City of New York. OM 25. D 304.
Sembrat, K. res. fel. zool. Yale. Bot 6. D 309.
Sembrat, Zofja res. fel. hist. & embr. Yale. Bot 6. D 309.
Shaw, I. techn. biol. Long Island. Br 118. Savery, Main.
Stern, K. G. visit. lect. phys. chem. Yale. L 21. Coogan, West.
Trager, W. asst. anim. path. Rockefeller Inst. Br 208. Stuart, School.
Vicari, Emelia M. res. assoc. anat. Cornell Med. Br 317. A 207.
Wolf, F. T. res. asst. bot. Wisconsin. Br 344. Hamblin, High.

CURRENTS IN THE HOLE

At the following hours (Daylight Saving Time) the current in the Hole turns to run from Buzzards Bay to Vineyard Sound:

Date	A. M.	P. M.
July 11	7:17	7:39
July 12	8:09	8:27
July 13	8:56	9:20
July 14	9:46	10:17
July 15	10:34	11:13
July 16	11:29	....
July 17	12:10	12:20

In each case the current changes approximately six hours later and runs from the Sound to the Bay.

ITEMS OF INTEREST

Dr. Ross G. Harrison, professor of biology at Yale University and director of the Osborn Zoological Laboratory, has been appointed to the board of scientific advisors in connection with the founding of the Jane Coffin Biological Memorial for Medical Research. The foundation, instituted by a gift of ten million dollars, will be concerned primarily with a search into the causes and origins of cancer.

Dr. Allen C. Scott has been promoted from instructor to assistant professor of biology at Union College. Dr. and Mrs. Scott are sailing for Europe after the closing of the Children's School of Science. The promotion of Dr. Scott creates a vacancy for an instructor in biology at Union College.

Dr. Katherine R. Jeffers, formerly instructor and research associate in zoology at the University of Missouri, has been appointed instructor in zoology at Duke University.

Dr. Elizabeth L. Sawyer, formerly instructor and research associate in zoology at the University of Missouri, has been appointed associate professor of biology at Converse College.

Dr. Ross C. MacCardle, formerly instructor in cytology at Temple University, has accepted an appointment in anatomy and histology in the Medical School of Duke University.

Proffessor James G. Needham, professor of entomology and limnology at Cornell University since 1907, has recently become professor emeritus. He is now writing a new monograph on North American Odonata.

Dr. Oscar W. Richards, formerly instructor in biology at Yale University, became on March 1, 1937 research biologist for the Spencer Lens Company. With this season, Dr. Richards concludes a service of nine years in charge of the chemical room of the Marine Biological Laboratory.

Dr. R. P. Bigelow, emeritus professor of zoology at the Massachusetts Institute of Technology, and Mrs. Bigelow are spending the summer at Fitzwilliam, New Hampshire.

Dr. Leigh Hoadley, professor of zoology at Harvard University, will be at Woods Hole only occasionally during the summer. His time will be divided between Cambridge and North Scituate.

Dr. Alfred M. Lucas, Associate Professor of Zoology at Iowa State College, Ames, Iowa, and his wife, Dr. Miriam Scott Lucas, will arrive in Woods Hole about July 28.

Prof. Harold H. Plough of the department of biology at Amherst College is working at the Tortugas laboratory on transplantation experiments in tunicates. He will be in Woods Hole the latter part of August.

Dr. G. Failla, physicist in charge of x-ray and radium work at Memorial Hospital, New York, upon arrival at Woods Hole this week was called immediately to Washington to be a witness before a joint committee of Congress considering a "Cancer Bill" designed "to promote research in the cause, prevention, and methods of diagnosis and treatment of cancer, to establish a National Cancer Center in the Public Health Service, and for other purposes." Dr. Failla left Wednesday and returned today.

Dr. John H. Northrop, Member of the Rockefeller Institute for Medical Research received the degree of Doctor of Science at the recent commencement of Yale University. Presenting Dr. Northrop for the honor, Professor Phelps said:

> "This man, born in Yonkers and with much of his life spent in New York City and in a laboratory in the Rockefeller Institute at Princeton, is paradoxically an outdoor naturalist and sportsman. He earned three degrees at Columbia, and set out in the world with a broad training in botany, zoology and chemistry. Since 1916 he has been in the Rockefeller Institute; but in the appropriate seasons, any one who gets up at dawn will find him outdoors with rod or gun. During the summer months he is in the North Country making important studies of potato culture and its blight, so that he has made a profitable union of work and play, for scientific research and human welfare. In his early days as a traveling fellow he was associated with the great biologist Jacques Loeb. His specialty has been the application of physical and chemical principles to fundamental biological problems. His work has illuminated many fields and he has made significant contributions to knowledge. His discoveries in pure science have also been of service to health. He solved the riddle of the enzyme; invisible ferments that had hitherto been known only by their action. From his investigations have come principles of wide applicability. He has recently shown that the so-called "Bacteriophage principle" is dependent upon a crystalline protein which is increased as the bacterial host is destroyed. These chemical substances simulate living matter in their behavior, and their discovery provides a basis for a broader concept of life itself. We welcome this scholar to-day into the Yale Brotherhood."

In awarding the degree, President Angell said:

> "It is to devoted scientists like yourself working quietly and without ostentation to discover the fundamental physical and chemical bases of life that men look for advance in the conquest of disease and in the building of wiser patterns of life. In recognition of your distinguished contributions in this field, Yale University confers upon you the degree of Doctor of Science and admits you to all its rights and privileges.

Dr. Northrup is expected at the Marine Biological Laboratory this summer.

DEPARTMENT OF CHEMICAL SUPPLIES AND SCIENTIFIC APPARATUS

Apparatus Room (Brick Bldg., Room 3)
Hours: 9:00 A. M. - 12, 1:30 - 4:00 P. M.,
Saturdays 9 - 12.

◆

Chemical Room (Brick Bldg., Room 8)
Hours: 8:30 A. M. - 12, 1:30 - 4:30 P. M.,
Saturdays 8:30 - 12.

The *Chemical Room* supplies chemicals, glassware, clamps and support stands for use only at the Marine Biological Laboratory.

Special apparatus, batteries (wet, dry and storage), microscopes and accessories, aspirators (or water pumps), electrical, physiological, and calibrated equipment, tools, bolting cloth, regulators and reducing valves for gas cylinders, and microtomes are to be obtained from the *Apparatus Room.*

The *Supply Department* (Frame Bldg. back of Brick Bldg.) supplies living and preserved organisms, paper, pens, graph paper, stationery, dissecting instruments, cheese cloth, shell vials and preserving bottles, slides and cover glasses.

Catalogs of chemicals and apparatus may be *borrowed* from the *Apparatus Room.*

Members of classes are not entitled to supplies other than those provided in their regular class work. Beginning investigators will receive supplies only on the authorization of the person under whom they are working for the season.

The pH of solutions may be determined by means of a glass electrode. Samples of 5-10 ml. should be placed in clean, dry test tubes with the name, room number, date and identification mark of the investigator and are to be left at the Chemical Room. The results will be *sent* to the investigator after measurement. The demands on this service by any one investigator may be limited.

When writing an order state definitely amounts, sizes and other necessary specifications of supplies needed. Concentrations of solutions should be given with other data needed for filling the order promptly. For other information the Annual Announcement and printed notices may be consulted.

The following standardized solutions will be furnished in limited quantities during the season of 1937. Special solutions, buffers, and pH standards must be ordered at least *two days* before they are needed.

N 1.000:
Acetic acid
Hydrochloric acid
Sulphuric acid
Sodium Hydroxide
N 0.100:
Hydrochloric acid
Sodium hydroxide
Buffer mixtures:
Acetate pH 3.6-5.6
Phosphate pH 5.4-8.0
Borate pH 7.6-10.0
Phosphate-citrate pH 2.2-8.0 (McIlvaine)
Indicators—Clark and Lubs series.
Color tube standards—on special order.

For other standards inquire of the person in charge at the Chemical Room. Investigators expecting to use special solutions or standardized reagents after September 1 are requested to notify the Chemical Room, if possible, before August 15. The standardized reagents are not usually available before *June 20* or after *September 10.*

Carbon dioxide, hydrogen, nitrogen and oxygen must be ordered by the investigator from the person in charge of the *Chemical Room* at least *ten days* before they are needed.

Unless special instructions are received orders from investigators will be filled in accordance with the *Formulae and Methods* of the Chemical Room published by The Collecting Net, 3rd ed. 1936, which include stain and chemical solubilities and the composition of solutions. Copies may be purchased at The Collecting Net office or the *Supply Department.* (75c).

Supplies no longer needed will be collected if word is left at the Chemical Room.

Investigators are urged to co-operate with the Chemical Room by cleaning their glass-ware before returning it at the completion of their work and by placing their name and date of departure on the Chemical Room Bulletin Board so that their supplies may be returned promptly by the janitors.

Supplies which an investigator plans to use during the next succeeding summer may be reserved when arrangements can be made. The more valuable equipment should be referred to Dr. S. E. Pond for record and segregated storage. Other material must be packed in boxes or cartons and properly labelled using a *Kept Out Card* (obtainable from the Chemical Room). All supplies not so listed and packed will be returned by the janitors. Should the investigator be unable to return the following summer the supplies will be returned to the Chemical Room stocks if they or the room is needed by other investigators.

Personal property, not connected with scientific research, should be stored elsewhere than in the Laboratory buildings.

Small amounts of special solutions will be kept during the winter for investigators in the Chemical Room on request. Supplies that may be injured by freezing should not be left in the wooden buildings.

Samuel E. Pond
Oscar W. Richards

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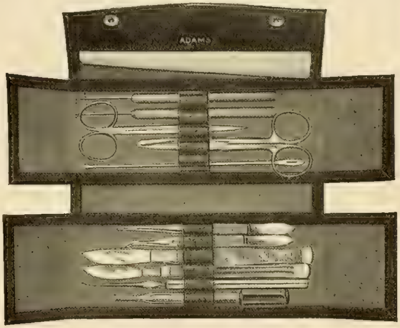

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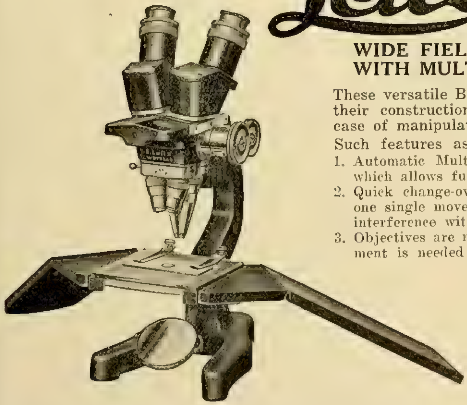

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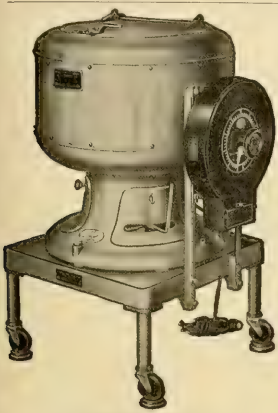

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DIRECTORY FOR 1937

(Continued from first number)

KEY

Laboratories	
Botany Building	Bot
Brick Building	Br
Lecture Hall	L
Main Room in Fisheries Laboratory	M
Old Main Building	OM
Rockefeller Bldg.	Rock

Residence	
Apartment	A
Dormitory	D
Drew House	Dr
Fisheries Residence	F
Homestead	Ho
Hubbard	H
Kahler	Ka
Kidder	K
Whitman	W

In the case of those individuals not living on laboratory property, the name of the landlord and the street are given. In the case of individuals living outside of Woods Hole, the place of residence is given in parentheses.

MARINE BIOLOGICAL LABORATORY

THE STAFF

ZOOLOGY

Investigation

Calkins, G. N. prof. proto. Columbia.
Conklin, E. G. prof. zool. emer. Princeton.
Grave, C. prof. zool. Washington.
Jennings, H. S. prof. zool. Hopkins.
Lillie, F. R. prof. embr. emer. Chicago.
McClung, C. E. prof. zool. Pennsylvania.
Mast, S. O. prof. zool. Hopkins.
Morgan, T. H. dir. biol. lab. California Inst. Tech.
Parker, G. H. prof. zool. emer. Harvard.
Wilson, E. B. prof. zool. emer. Columbia.
Woodruff, L. L. prof. proto. Yale.

Instruction

Bissonnette, T. H. prof. biol. Trinity. in charge.
Crowell, P. S. Jr. instr. biol. Miami.
Hadley, C. E. assoc. prof. biol. N. J. State Teachers.
Kille, F. R. asst. prof. zool. Swarthmore.
Lucas, A. M. assoc. prof. zool. Iowa State.
Matthews, S. A. assoc. anat. Pennsylvania med.
Nelsen, O. E. asst. prof. zool. Pennsylvania.
Sayles, L. P. asst. prof. biol. City of New York.
Waterman, A. J. asst. prof. biol. Williams.

PROTOZOOLOGY

Investigation (See Zoology)

Instruction

Calkins, G. N. prof. zool. Columbia. in charge.
Kidder, G. W. instr. zool. City of New York.
Hughes, Elizabeth Drumtra instr. zool. Wilson.

EMBRYOLOGY

Investigation (See Zoology)

Instruction

Barth, L. G. asst. prof. zool. Columbia.
Goodrich, H. B. prof. biol. Wesleyan.
Grave, B. H. prof. zool. De Pauw. (absent 1937).
Hamburger, V. asst. prof. zool. Washington (St. Louis).
Packard, C. asst. prof. zool. Columbia.
Schotté, O. asst. prof. biol. Amherst.

PHYSIOLOGY

Investigation

Amberson, W. R. prof. phys. Tennessee.
Bradley, H. C. prof. phys. chem. Wisconsin.
Garrey, W. E. prof. phys. Vanderbilt Med.
Lillie, R. S. prof. gen. phys. Chicago.
Mathews, A. P. prof. biochem. Cincinnati.

Instruction

Chambers, R. prof. biol. New York.
Ferguson, J. K. W. asst. prof. phys. Ohio State.
Fisher, K. C. instr. zool. Maine.
Höber, R. visit. prof. phys. Pennsylvania.
Irving, L. prof. exp. biol. Toronto. in charge.
Prosser, C. L. asst. prof. phys. Clark.
Sichel, F. J. M. instr. phys. Howard med.

BOTANY

Investigation

Allen, C. E. prof. bot. Wisconsin.
Brooks, S. C. prof. zool. California.
Duggar, B. M. prof. phys. & econ. bot. Wisconsin.
Lewis, I. F. prof. biol. Virginia.
Robbins, W. J. prof. bot. Missouri.

Instruction

Drouet, F. res. fel. Yale.
Prescott, G. W. asst. prof. biol. Albion.
Taylor, W. R. prof. bot. Michigan. in charge.

OFFICE OF ADMINISTRATION

Baker, Marjorie sec. Simmons. W D.
Billings, Edith sec. Millfield.
Crowell, Polly L. asst. to bus. mgr. Main.
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THE JOURNAL OF INDUSTRIAL AND ENGINEERING CHEMISTRY

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THE COLLECTING NET

Cattell, W. assoc. ed. Scientific Monthly. OM 1. North.
Clark, Anna-Betty grad. zool. Columbia. 140. Neal, Bar Neck.
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Kraatz, C. P. instr. phys. Chicago Med. 140. A 105.

NOTE: The directory for 1937 will be issued in pamphlet form on July 13; it will combine the material included in the first two issues, adding to it new names received by 9:00 A. M. on Monday. Single copies will cost 25c.

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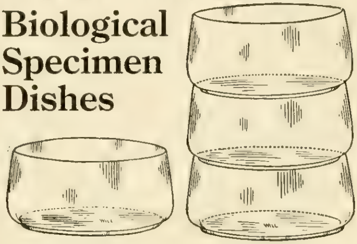

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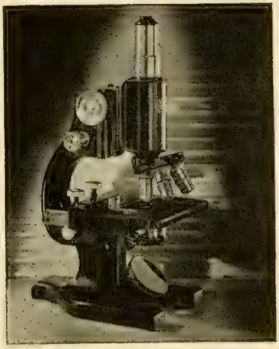

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Photograph by M. Schalk

"ATLANTIS" SETTING SAIL OFF MARTHA'S VINEYARD

The research and exploration ketch of the Woods Hole Oceanographic Institution which left on Thursday for the Sargasso Sea (35° Latitude, 67° Longitude) some 350 miles from Woods Hole.

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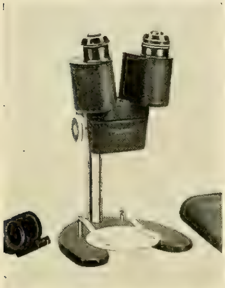

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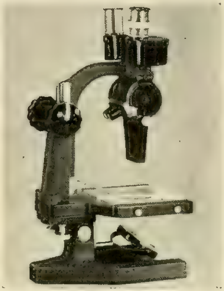

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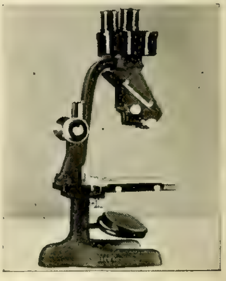

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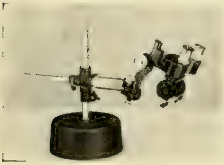

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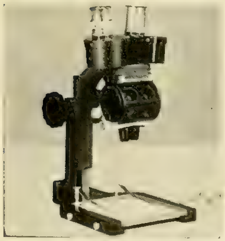

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THE COLLECTING NET

Vol. XII, No. 3 SATURDAY, JULY 17, 1937 Annual Subscription, $2.00 Single Copies, 30 Cents.

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THE WORK AT THE SCRIPPS INSTITUTION OF OCEANOGRAPHY

Dr. H. U. Sverdrup, *Director*

The Scripps Institution of Oceanography has, as known from previous articles in The Collecting Net (No. 8, 1933; No. 5, 1936) a large resident staff and a research program which is conducted continually through the year. Visitors come to the Institution during every part of the year but for obvious reasons the summer is the season in which the Institution has the greatest number of visiting scientists. These come after having made special arrangements with a member of the staff with whom they wish to work, or in order to take up a special problem of their own.

A summary of the biological research at the Scripps Institution was given by Dr. ZoBell in The Collecting Net No. 5, 1936. Since no essential change has been made in this part of the Institution's program, it seems unnecessary to give an account of the studies which are in progress in the various divisions. One noteworthy expansion has, however, taken place. In cooperation with the U. S. Navy's Bureau of Construction and (*Continued on page* 59)

M. B. L. Calendar

TUESDAY, July 20, 8:00 P. M.

Seminar: Dr. L. G. Barth: "Chemical Stimulation of the Amphibian Ectoderm."

Dr. Viktor Hamburger: "Limb Bud Transplantation in Chick Embryos."

Dr. Oscar E. Schotté: "Adult Organizers and Their Action in Adult Tissue."

Dr. L. S. Stone: "The Development of a Salamander; *Amblystoma punctatum.*"

WEDNESDAY, July 21, 8:00 P. M.

Lecture: Professor Edgar Allen: "Ovulation in Mammals and Internal Secretions Involved."

FRIDAY, July 23, 8:00 P. M.

Lecture: Dr. Leonor Michaelis: "The Problem of the Oxidation of Organic Compounds and Its Catalysis under Biological Conditions."

ELECTRICAL POTENTIALS OF THE HUMAN BRAIN

Dr. E. Newton Harvey

Professor of Biology, Princeton University

If small metal electrodes are fastened to the scalp of a person, connected with a high gain amplifier, and the resulting electrical potentials observed or recorded, it is found that regular rhythmic changes in potential occur of five to several hundred microvolts amplitude and one to .03 seconds duration. They come from the cerebral cortex and give us an objective method of investigating activity of the brain. The most interesting and best known of these rhythms has a frequency of about 10 per second and is called the alpha rhythm. It is affected by vision, emotional states, sleep and many other conditions. It is most apparent in some persons lying quietly with eyes closed and immediately disappears if the eyes are opened to view an object.

A series of over 200 records with 70 individuals of all ages has demonstrated that these potentials of the brain recorded from similar positions on the scalp of normal persons differ greatly in pattern. Two types of individuals, with every

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WOODS HOLE PHOTOBIOLOGY

(THE COLLECTING NET welcomes contributions for this page. Staff pictures shown except where credit is given in parentheses).

Left to right: Top row, Ice on Great Harbor and an unhappy expression (Weber); Dr. and Mrs. Jean Brachet; Seal siesta in the Fisheries' pool (Weber); Second row, The Yalden sundial with Mr. Rutherford Boyd, artist, and Mr. Robert A. Baillie, sculptor; The south face of the dial and Mr. Baillie; Dr. Oscar Schotté and Dr. Chas. Packard; Third row, Dr. Viktor Hamburger; A hot day on Breakwater beach; Great Harbor from "The Collecting Net" office; Dr. Rudolf Höber; Mr. Columbus Iselin; Fourth row, Dissection on torpedo ray by Dr. Abby Turner (Chambers); Dr. Gary N. Calkins; Dr. G. H. Parker; "Atlantis" under Diesel power setting out for Sargasso sea on July 8; Fifth row, The turnbridge of the Fisheries' enclosure at dusk (Weber); Old clothes dance at MBL Club, 1936; Two viewpoints on the beach situation.

possible intergrade, can be distinguished; at one extreme the type with almost continuous pure alpha (ten a second) rhythm; at the other the type with practically no alpha rhythm but with less regular higher frequency, so called beta potentials. One interesting case was observed of no alpha rhythm except for a few seconds after the eyes had been closed. This appeared whether the room had previously been lighted or was completely dark.

During sleep, the potential patterns change completely. They are so characteristic that they may be used as a criterion of states or depth of sleep. In a person showing continuous alpha rhythm we may distinguish the following states, described in the order in which they appear as a person sleeps:—(A) *Interrupted alpha,* i.e., more and more marked interruption of the alpha rhythm; (B) *Low voltage,* complete disappearance of the alpha activity with only low voltage changes of potential; (C) *Spindles,* the record slightly irregular with short 14 per second rhythms or "spindles" every few seconds; (D) *Spindles plus random,* random potentials plus short bursts of 14 per second rhythm; (E) *Random,* the spindles become inconspicuous but the large random potentials persist and come from all parts of the head.

The non-alpha type of person passes into the same states of sleep as the alpha type but it is difficult to distinguish states A and B. State B is characterized by less high frequency potentials.

During a night's sleep or an afternoon nap, there is a continual shift of the person from one state to another. The changes are usually sudden but may be gradual, especially from C to D and from D to E. There is no evidence of a continuous curve of sleep although it is more difficult to awaken a person in states D and E. The changes in state of sleep may be plotted against time and give a sleep record or hypnogram.

Movements may occur without any change in state of sleep and a change in state of sleep may occur without movement but occasionally the two are connected. After a movement the state usually changes upward and, when in the B state, alpha rhythm for a few seconds (A state) almost always occurs after a movement.

Stimuli or disturbances may shift the state of sleep suddenly. The shift is always upward, from one state to the next above or one or two states may be skipped. Lack of a continued stimulus to which a sleeper is accustomed may act as a disturbance. Changes in state of sleep have been observed with no detectable external stimuli, but internal changes may be responsible. The ease of changing a state of sleep depends on which state the subject is in, changes appearing less and less frequently as the sleeper approaches the E level. These changes in state as the result of stimuli are frequently but not always accompanied by movement.

Finally it must be emphasized that changes in pattern of brain activity after a stimulus are not the direct representation in the cortex of impulses from that particular sensory pathway but represent changes in state of cortical activity over wide areas. This is particularly evident in sleep. Thus a sound may result in the appearance of alpha rhythm for a few seconds but we interpret this as representing a change in level of consciousness rather than a direct effect of the sound stimulus.

Evidence from two sleepers who awoke after dreaming lead us to believe that dreams occur in the B state but are not represented by any peculiar type of potential.

(This article is based upon an evening lecture presented at the Marine Biological Laboratory on July 9. The investigations were carried out at the Loomis Laboratory, Tuxedo Park, in collaboration with Mr. Alfred L. Loomis and Mr. Garret A. Hobart III).

DISCUSSION OF THE LECTURE OF DR. HARVEY BY DETLEV W. BRONK, DIRECTOR OF THE JOHNSON FOUNDATION, UNIVERSITY OF PENNSYLVANIA

We have derived much of our knowledge concerning the properties and mechanisms of nervous tissue from a study of its bioelectric phenomena. For the action potentials are important signs of the intimate processes involved in the action as well as convenient indicators of the transmitted impulse. It is reasonable to assume therefore that the electrical studies of cerebral processes described in such an interesting and lucid manner by Professor Harvey will yield valuable information concerning the activity of the cortex and the nature of the events involved in that activity. It should be an especially valuable tool for securing clues as to the mechanism of such obscure problems as sleep.

Rhythmicity is characteristic of the nervous system. The brain and spinal cord are continually subjected to series of rhythmically recurring afferent impulses, the motor nerve cells rhythmically discharge impulses to the effector organs, and in many cases these discharges are rhythmically interrupted to give a second periodicity as in the case of the respiratory and sympathetic motor nerve cells. But it was scarcely to have been expected that electrodes recording the activity of vast numbers of neurones with diverse functions would reveal periodic fluctuations of potential indicative of synchronized activity. One of the major problems in this field is accordingly an ultimate analysis of the factors responsible for the synchronized excitation of many nerve cells.

An adequate understanding of that problem will undoubtedly develop from two lines of attack. The first is that of electroencephalography as described by Professor Harvey and the other is a study of the activity of the individual neurones and synapses. Out of the axon and cell potentials the electroencephalogram is compounded and in terms of those constituent events we shall eventually be able to interpret the evidence recorded from the unexposed human cerebrum.

THE WORK AT THE SCRIPPS INSTITUTION OF OCEANOGRAPHY

(Continued from page 57)

Repair a systematic study of the organisms which cause fouling of ship's bottoms is being initiated. The Bureau of Construction and Repair has secured the assistance of Mr. W. Forest Whedon and will take care of his direct expenses for instruments and materials, while the Scripps Institution will provide laboratory space for his work and place the facilities of the Institution at his disposal. Mr. Whedon will work in close contact with Professor W. E. Allen and Dr. Claude E. ZoBell, both of whom have conducted studies of the "fouling organisms." The Institution had to drop this special investigation from its program owing to lack of funds and the necessity of attacking other problems which appeared to be of greater interest to the whole program. Thanks to the cooperation of the Navy, it is now possible to take the problem up again and it is hoped that the cooperation will continue over a series of years and that the investigation will render results of practical application.

A new feature has been introduced in the summer activities of the Institution. Previously the instruction at the Institution has been limited to graduate instruction leading to a doctor's degree in oceanography. It was felt that it would be highly desirable that graduate students who come here for advanced work have a general knowledge of the whole field of oceanography. In order to fill this need a lecture course, "Introduction to Oceanography," is now being offered during the summer session of UCLA. The course is entered as an upper division undergraduate course, extended over six weeks with ten lectures a week. It is being conducted by Drs. Fleming, Johnson and Sverdrup, who deal with the geographical features of the oceans, sedimentation, chemistry of sea water, the movements of sea water, and the organisms in the sea. This summer the attendance is small but we hope to obtain a larger number of students when the course is better known and we hope that it will be taken not only by students who wish to specialize in oceanography but by others who are interested in learning more about the sea.

In connection with the question of instruction it should also be mentioned that in the future students can work at the Scripps Institution towards a degree in fields of study offered by groups of departments of the University of California, such as microbiology or comparative physiology.

The Institution's work at sea has been seriously handicapped during the last winter since on November 13, 1936, the Institution's research vessel, the *Scripps*, was lost owing to explosion and fire. The Institution shall not have any possibility for operations at sea during the coming summer but it is hoped that such operations can be continued on a larger scale from the beginning of the fall. In April this year Mr. R. P. Scripps, who's generous support has been invaluable to the Institution, bought the 104 foot long auxiliary schooner *Serena* and placed a substantial sum at the disposal of the Institution for remodelling this vessel and equipping it for oceanographic work. The remodelling, which includes installation of a 24 horse power diesel auxiliary motor, building of a small deckhouse with a deck laboratory, and re-arranging the quarters below deck in order to obtain laboratory space, is at present well under way. The boat will have sleeping accommodations for a crew of nine (if necessary) and a scientific party of six. On shorter cruises four more berths can be arranged. It will be equipped with three winches, one carrying 20,000 feet of $\frac{3}{8}$ inch wire to be used for deep sea trawling, dredging and anchoring, one carrying 20,000 feet of $^{5}/_{32}$ inch wire to be used for obtaining water samples and temperatures, and one carrying 7,000 feet of wire to be used principally for vertical net hauls. All winches will be equipped with electric motors of sufficient power.

In the coming winter the new research vessel will be used for two different purposes. A systematic study of the waters off the coast of Cali-

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THE COLLECTING NET has been entered as second-class matter July 11, 1935, at the Post Office at Woods Hole, Massachusetts, under the Act of March 3, 1879. It is devoted to the scientific work at marine biological laboratories. It is published weekly for ten weeks between June 1 and September 15 from Woods Hole and printed at The Darwin Press, New Bedford. Its editorial offices are situated on the third floor of the Woods Hole station of the United States Bureau of Fisheries. Between June 1 and October 1 communications should be addressed to Woods Hole, Massachusetts; at other times they should be directed to THE COLLECTING NET, Garrison, N. Y. Single copies cost 30c; a subscription (containing not less than 280 pages) costs $2.00.

fornia will be commenced. The area which is to be covered will depend upon the experiences gained but it is probable that we will concentrate our studies in the region between San Francisco and San Diego and to a distance of two to five hundred miles from the coast. During the first cruises the emphasis will probably be placed on the physical-chemical investigations but gradually a survey of the marine life will be undertaken.

A second study will deal with certain features of the submarine geography off the coast of California. This will be conducted by Dr. F. P. Shepard who, for this purpose, has obtained a grant from the Geological Society of America and who will have the disposal of the Institution's new vessel during approximately six months of the coming year. Dr. Shepard will stay at the Institution from September 1.

Thanks to the cooperation of the California State Fish and Game Commission the Institution has been able to undertake a considerable amount of work at sea during this spring and summer. The Fish and Game Commission is interested in all questions concerning sardines and wished, in connection with certain studies, to obtain more definite information as to the character of the surface current in the offshore region between Point Conception and San Diego where great quantities of sardine eggs and larva generally are found in and after the spawning season. For this purpose the Commission proposed to undertake a large scale drift bottle experiment during which sealed bottles should be thrown out from a number of stations scattered over the field. It was hoped that a number of these bottles would drift ashore and that the enclosed cards would be returned to the Office of the Commission. When these plans were discussed it was suggested that the SIO should cooperate and occupy about thirty oceanographic stations during each of the three cruises which were planned. The stations should be located on four lines running nearly at right angles to the coast and to a distance of 140 to 160 miles such that the outer stations would be well beyond the continental slope. At all stations salinity, temperature, and oxygen should be determined at different levels from the surface and to a depth of 2000 meters, or to the bottom if the distance to the bottom was less than 2000 meters.

The three cruises have now been completed, one in the beginning of April(one in the middle of May, and the last in the beginning of July. The first two cruises have already given a great amount of interesting information. Bottles have been recovered only from stations near the coast and the drift of these bottles is in perfect agreement with the surface currents which have been computed on the basis of observed temperatures and salinities. At some distance from the coast but inside of the continental slope large irregular eddies occur in the area which has been assumed to be one of the major spawning grounds of the sardines. Eggs and larva will probably remain in this region for a long time. The results also throw light upon the mechanism of upwelling and upon the manner in which nutrient salts are brought to the surface. The present results indicate that the upwelling water which is rich in nutrient salts is not carried to any great distance from the coast but remains within a relatively narrow belt of water. If this is true it has great bearing on the biological problems off the coast. These results are very suggestive; they indicate a number of problems, some of which we hope to be able to attack systematically when our new research vessel is ready for work at sea.

THE EFFECTS OF FATIGUE DUE TO MUSCULAR EXERCISE ON THE PURKINJE CELLS OF THE CEREBELLUM OF MICE AT VARIOUS AGES

Dr. Warren Andrew

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The problem of morphological changes in nerve cells as the result of functional activity has been studied by a number of investigators, beginning with the latter part of the past century and continuing to the present day. Nevertheless, the question still remains open for dispute not only as to what changes occur due to activity but as to whether any such changes do occur.

In 1892 C. F. Hodge found a decrease in size of cells and nuclei as the result of fatigue. In 1909 David H. Dolley made a rather elaborate presentation of the results of his study of the Purkinje cells of dogs fatigued in a treadmill. He listed 13 "stages" through which the nerve cell passes in activity and fatigue, ending in an enlarged, "edematous," hypochromatic condition.

Those of the earlier investigators who carried out the most careful work have stressed the point that certain factors must be taken into account. Among these is age. In 1892 Hodge said: "In order to properly define the results already obtained, it will be necessary to know two things: 1. Exactly what changes take place in nerve cells under variations of food and water supply. 2. What changes, if any, take place in nerve cells from birth to death from old age, from rejuvenation to senescence."

The present experimental work is based on two years of work carried on previously in which the Purkinje cells of the cerebellum of mice and rats were studied from the time of their differentiation up to and including extreme senility of the individual. In very young animals the cells possess smooth outlines, clear nuclei, and densely packed Nissl substance. In young adults the Nissl substance is abundant in the form of discrete granules, the nuclei are easily differentiated from the cytoplasm under the low power of the microscope and the cell outlines are smooth. In senile animals the cells frequently contain little or no Nissl substance, the nuclei are basophilic, making it difficult to distinguish them from the cytoplasm under low power magnification, and the outlines of cells and nuclei are often jagged and irregular.

Since the cause of much of the uncertainty existing in the field seems to me to be due to the complexity of procedure and presentation of results of earlier workers, the procedure and recording of results in the present work were made as simple as possible. Sixteen black mice were used. "Fatigue" in this work means complete exhaustion brought about by forced running in a motor-driven rotary cage. For each fatigued animal, a control animal of the same brood was killed at the same time and the tissues from the two animals carried through the technical processes together. The animals represent a range of ages including pairs of 23 days, 25 days, 43 days, 46 days, 98 days, 101 days, 746 days and two animals with marked signs of senility—of 744 and 746 days, killed without fatiguing. In each case 100 cells were examined, these cells being taken from corresponding parts of corresponding convolutions of the two animals.

In one pair only, the youngest, there occurred a decrease in the size of the cells. In the 43 day old pair, the cell-size remained about stationary, while in the remaining five pairs the cell-size was distinctly increased.

The number of hypochromatic cells increases steadily as we pass from the young to the senile animals and also as we compare the exhausted to the fresh animals among the adult and senile mice. There is also a great increase in the number of basophilic as contrasted to clear nuclei when we compare the older to the younger animals and also when we compare the exhausted to the fresh animals among adult and senile mice.

The binucleate condition of the Purkinje cell is found to be a phenomenon of senility, no such cells having been seen in younger animals, while they are present in all four of the senile specimens examined.

The two major conclusions to be drawn from the present work are: 1. There are morphological changes in nerve cells as the result of fatigue carried to exhaustion, consisting primarily in a loss of Nissl material, an increased basophilic property of the nucleus and an increased average cell size. 2. The differences between the Purkinje cells of senile and of young animals are far more marked than are those between exhausted and fresh animals of the same age.

LOCALIZATION IN THE OCULOMOTOR NUCLEI OF THE GOLDFISH

Mr. Zareh Hadidian, Mr. Milton S. Dunn and Dr. Roland Walker
Rensselaer Polytechnic Institute

In mammals having binocular vision various authors have described the subdivision of the oculomotor nuclei into centers for the individual eye muscles. On the basis of the anatomical relations between these and the trochlear and abducens nuclei, attempts have been made to interpret the mechanism for the observed coordination of eye movements. In the goldfish not only do the oblique and rectus muscles bear different relations to the optic axes, but also the two eyes have a linked coordination different from that in binocular vision, so that entirely different sets of eye muscles must be physiologically associated as synergists. The oculomotor nuclei of the goldfish were studied with respect to the position of cells innervating the individual muscles to see whether there is any pattern which might be correlated with the type of eye coordination.

The method used was a study of chromatolysis in the oculomotor cell bodies about two weeks after damage to peripheral structures. In normal animals there was a negligible percentage of cells showing advanced stages of degeneration and in animals from which both eyes had been removed practically all the cells were markedly chromatolyzed. There were no changes in the nuclei studied after removal of the contents of an eyeball. When one orbit was carefully cleaned out, thus insuring damage to all fibers of the oculomotor and trochlear nerves of that side, about half of all the oculomotor and trochlear cells of both sides showed degenerative changes. Chromatolysis in the trochlear nucleus was almost entirely contralateral, while the degenerate oculomotor cells were about 70% homolateral. Only 10-15% of the chromatolysis in the dorsolateral parts of the oculomotor nuclei was crossed, but in the ventromedial parts about half the cells on each side were degenerate.

The branch of the III nerve to the inferior oblique is the only one readily accessible to individual operation, but the results of cutting this branch were closely similar to those of cutting the inferior oblique muscle itself. So, for the rest of the localized operations, no attempt was made to reach the nerve directly, but chromatolysis was studied after sectioning the anterior rectus, inferior rectus, or superior rectus muscles.

Chromatolysis after damage to the inferior oblique muscle or its nerve is about 80% homolateral, with a slight tendency toward ventromedial localization. For the anterior rectus degeneration is about 60% homolateral with no localization. The inferior rectus shows about 85% homolateral degeneration, with definite localization in the dorsolateral nucleus anteriorly changing gradually toward the ventromedial nucleus posteriorly. The superior rectus has only about 20% homolateral cells and the contralateral group is localized in the ventromedial nucleus.

A consideration of these results leads to the conclusion that since there is poor definition of cell groups and scattering of cells for any one muscle throughout the nucleus, any merely anatomical studies of oculomotor localization are inadequate for the understanding of the type of eye coordination in the goldfish.

(This article is based on a seminar report given at the Marine Biological Laboratory on July 13).

SOME NEW OBSERVATIONS ON THE SECRETORY ACTIVITY OF NEURONS

DR. ERNST SCHARRER
In charge of the Neurologisches Institut, Frankfurt

Nerve cells having more or less the appearance of secretory cells have a wide distribution. Among the invertebrates they have been found in annelids, molluscs, crustaceans and insects. In the vertebrates active secretory cells are chiefly found in the diencephalon of selachians, teleosts, amphibia, reptiles and mammals including man. In the bony fishes, gland-nerve cells have also been found in the nucleus of the nervus terminalis, in the midbrain and, in some genera, in the caudal region of the spinal cord. The latter ones are specially well developed in selachians (Speidel 1919, 1922). All stages can be found from typical nerve cells, with only a few granules in their cytoplasma in some species, to cells with a spectacular formation and storage of droplets of a colloid-like substance. There are even cases such as the Mediterranean fish Cristiceps where the nerve cells in the so called "diencephalic gland" are transformed into gland cells lacking any nervous character. A marked nuclear polymorphism is also typical for many gland-nerve cells and pericellular as well as endocellular blood capillaries are often observed in the secretory diencephalic nuclei of vertebrates.

Observations of this kind, even when based on so much material as this, would not be sufficient to prove the glandular function of the cells in question. It must be shown that there is a functional cycle in the production of the colloid material by the nerve cells in the neurosecretory regions of the nervous system. This has been done on the diencephalic gland (Nucleus praeopticus) of the American toad (*Bufo americanus*). Sections through the diencephalic gland of the toad show all stages from the first appearance of fine granules in the cytoplasma of the cells, which stain brilliantly orange in Azan preparations, to bigger droplets which finally are extruded and lie as colloid masses among the cells. This cycle can clearly be shown and the identity of those processes in nerve cells with the different stages of secretory activity in gland cells seems sufficiently demonstrated.

The physiological meaning of the gland-nerve cells is still unknown and a wide field for future investigations seems to be open.

(This article is based upon a seminar report given at the Marine Biological Laboratory on July 13).

SYNAPTIC TRANSMISSION IN THE SIXTH ABDOMINAL GANGLION OF THE CRAYFISH

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Transmission through the sixth abdominal ganglion of the crayfish was studied by simultaneous recording of impulses entering and leaving the ganglion in response to stimulation of caudal sensory hairs. Flexion of one hair gives rise to one sensory impulse. To set off one efferent unit, however, summation of two to four afferent impulses in different fibers is necessary. No efferent neurone is excited by one incoming impulse. When several efferent units are excited more afferent impulses are required to activate the first efferent unit in a response than to activate later ones. Thus both convergence and overlap play a part in conduction through this ganglion.

Ganglionic delays range from 3 to 30 msecs. as measured from the time the first sensory impulse enters the ganglion. Most of the fastest units show delays of 5 - 6 msec. and later ones fall in groups which are multiples of the first. This multimodal distribution of delays is interpreted as indicating the existence of internuncial neurones. A given unit may show fluctuation of 2 - 3 msecs.

in synaptic delay. The afferent neurones respond to stimuli separated by intervals as short as .01 sec., whereas the efferents show recovery times of .05 to .1 sec. This synaptic recovery time is longer than that of the fibers, hence no relatively refractory period of the synapse can be detected in the responses of the individual efferent units.

There are no connections from tactile receptors across the ganglion to contralateral efferent nerves of the sixth segment.

Acetylcholine and eserine have no facilitating action upon the synapse. Eserine is toxic in high concentrations. Nicotine blocks conduction through the synapse. Excess potassium reduces action potentials in the afferent fibers and may block them before affecting the synapse. Adrenaline acts similarly to excess potassium.

It is concluded that those humoral agents which mediate transmission in some mammalian ganglia do not have a similar action in this crayfish ganglion.

(This article is based upon a seminar report presented at the Marine Biological Laboratory on July 13).

DEPARTMENT OF PUBLICATIONS

A STORY OF THE FIRST ZOOLOGIST IN ALASKA

GEORG WILHELM STELLER, THE PIONEER OF ALASKAN NATURAL HISTORY. By Leonhard Stejneger. Harvard University Press, 1936, XXIV. 623 pages; frontispiece, 29 plates, index. $6.00.

This book is much more than the biography of a famous naturalist who, under the auspices of the Imperial Russian Academy of Sciences, made pioneer zoological and botanical investigations in Siberia, Kamchatka, the Bering Sea and was the first European scientist to set foot on Alaskan soil. Stejneger's book written with remarkable care and representing the results of many years of studies and search for the original documents scattered over the three continents and buried in the archives of at least four different countries, gives to the reader a vivid picture of life in Germany and Russia, as well as a detailed account of the most unusual experiences of the great zoologist.

During the second quarter of the 18th century unprecedented opportunities presented by the recently established Russian Academy of Sciences in St. Petersburg attracted large numbers of young and old European scientists lured to the Empire of the Tzars by good salaries, adventure and the possibilities of large scale explorations in the theretofore unknown eastern part of Europe and Asia. In 1734, to this Mecca for adventurous explorers, came Georg Steller, none too well provided with worldly goods but well supplied with hope, energy and a splendid education received in the universities of Wittenberg and Halle. It was not, however, an easy matter to obtain a scientific position in the Academy as he had hoped, and the young naturalist was fortunate to be introduced to Archbishop Theophan, a famous preacher, writer, scholar, and friend of the late Tzar, Peter the Great. The Archbishop installed him in his own household. Elated with his good fortune and not familiar with Russian conditions, Steller painted his success in glowing terms considering his position equivalent to that of a "Leibmedicus," overlooking the fact that Theophan, a very sick man, had already his own personal physician. He could not have found, however, a more powerful and benevolent protector who highly recommended the young naturalist as a most fitting candidate for a position of naturalist in the second Kamchatka Expedition. From this time on Steller's life and achievements were intimately connected with this ambitious project which assumed grandiose proportions and lasted for nearly a decade. Developed in 1732, the project comprised the following: "Nautical survey and mapping of the entire area of northern Asia and adjacent parts of America down to California; the coast of the Arctic Ocean to be chartered; astronomical positions were to be established throughout Siberia; two vessels to be built on the coast of eastern wilderness and the still doubtful relation between the two continents was to be cleared up definitely; three other vessels also to be built and equipped out there, were to survey Kuril Island, Japan, and other areas of eastern Asia." Furthermore, the scientists attached to the expedition were directed to make geological, biological, ethnological, anthropological, linguistic and historical surveys of the same territory. Three members of the Academy, De la Croyere, Müller and Gmelin were already exploring Siberia in 1737 when Steller was appointed "adjunct in natural history" at a salary of 660 rubles a year and began his eastward journey and explorations in the Siberian wilderness.

Stejneger's book takes you through numberless adventures experienced by Steller and other members of the expedition depicting the remarkable perseverance and explorer's urge which drove this man of tremendous will power and determination through almost unsurmountable difficulties. One begins to share the author's admiration of his hero when reading the account of the discovery of Alaska and the results of less than half a day's sojourn (July 17, 1841) on Kayak Island. After lengthy arguments with Bering, the leader of the expedition, Steller was permitted to accompany a landing party sent to bring a supply of fresh water. He spends six hours in hectic collecting, recording and exploring and sitting for one hour on the beach while waiting for a boat, writes his famous paper, "Catalogus plantarum intra sex horas . . . observatorum," the first scientific paper relative to Alaska. The return voyage was an unlucky one. The ship "St. Peter" was wrecked and beached on what is at present known as Bering Island, named for the gallant leader of the expedition. The shipwrecked crew abandoned the vessel and for eight and a half months lived in huts dug in sand banks. Scurvy developed and out of 78 officers and men, 31 died, including Bering. The morale of the crew was gone, and discipline was maintained with great difficulty. Under these hardships and agonizing sufferings, Steller continued his explorations, collecting mammals, birds, fish, and mollusks; describing new forms and giving accounts of their habits. After many unsuccessful efforts the crew was fortunate in killing a sea cow, or northern Manatee, an animal now extinct. Steller was the only naturalist to see this remarkable animal alive. He observed and described its mode of living and gave an account of its anatomy. One stands amazed at the work accomplished by this remarkable man under the difficulties which now-a-days would probably be unsurmountable to scientists accustomed to the luxuries of the modern laboratories. How would one like to make anatomical dissections of a 30 foot animal under the following conditions? "The weather at the time of capture," writes Steller, "was almost constantly rainy and cold. The observations could only be made in the open air and during a certain stage of tides of the sea. Packs of most despicable Arctic foxes were tearing with their vile teeth and stealing everything from under my very hands, carrying off my papers, books and inkstand while I examined the animal, and ripping it while I was writing."

Besides the study of sea cows, Steller made numerous observations on other animals and plants of the island accumulating large numbers of dried preparations for which there was no room in a small boat which was built from the wreck of the "St. Peter." All this precious material was left on the uninhabited island to be devoured by the bold foxes which had so greatly annoyed him. With the manuscripts and dried seeds of American and Bering Island plants, he managed to take along only a pair of the horny palatal plates of the sea cow. Nearly 150 years later a complete skeleton of the animal was brought to this country by his biographer who was sent to Bering Island by Professor Spencer Baird, Secretary of the Smithsonian Institution and first Commissioner of Fisheries.

Steller made numerous observations on fur seals, spending six consecutive hours in a little temporary hut built in the middle of a rockery surrounded by the noisy males and their harems. His observations on their matings, fights, parental care, play of the new-born pups and their first attempts at swimming and other actions described in the report published 10 years later by the Russian Academy of Sciences, are so complete that only a few additions and corrections were made a century later when the American Government took possession of the Pribilof Islands and reported on the fur-seal herd acquired by the United States.

Steller's ornithological studies resulted in another sensational discovery of the flightless spectacled cormorant (*Phalacrocorax perspicillatus*) a large bird which like the sea cow, is known only on Bering Island and has similarly been exterminated by ruthless hunting.

Enchanted by Stejneger's style and sympathy for his fellow naturalist, the reader follows the life of this great scientist with never fading interest. The meticulous care of the author and his attention to details of biographical study do not interfere, as one would expect, with the high literary qualities of the book. From the first page to the last chapters describing Steller's journey home, interrupted by his arrest (due primarily to misunderstanding and difficulties in communicating with the Government in St. Petersburg), and finally his release and untimely death, this biography reads like the most fascinating fiction. Yet every event is fully corroborated by historical evidence and use of the original documents. The author should be given great credit for accuracy and correctness in dealing with Russian history of this period, not an easy matter for a person not well versed in the intricacies of the Russian language of the 18th century. The beginner and the mature zoologist as well as the layman will greatly profit by reading this admirable and scholarly book. —*Paul S. Galtsoff*

MR. HAROLD S. PETERS, ornithologist and entomologist of the U. S. Biological Survey, will study the effect of the shortage of eelgrass on the Atlantic brant at its nesting grounds on the Labrador peninsula and Baffin Island. The shortage of eelgrass, their principal food, has seriously affected these birds.

DR. C. W. METZ of the Carnegie Institution, and family, are spending the summer at Westmoreland Depot, New Hampshire.

PROFESSOR ELBERT C. COLE, head of the department of biology and formerly in charge of the M. B. L. invertebrate course, sailed on July 13 with a party of investigators and students for the Barro Colorado Island Laboratory, Gatun Lake, Panama Canal Zone. The group will undertake scientific studies and make collections for Williams College.

THE YALDEN SUNDIAL

On the waterfront in direct line with the axis of the main building of the Marine Biological Laboratory is the new vertical Yalden sundial, which bears an inscription "Presented by Charles R. Crane, 1937." The structure, carved of Batesville marble from the Arkansas hills, the hardest limestone in America, embodies an octagonal theme in the broad base and seat encircling the central pillar of the dial.

On the riser of the top step of the base facing the east are the small letters, "Designed by J. Ernest G. Yalden—Rutherford Boyd." Dr. Yalden, who died on February 22, 1937, before the erection of the dial now a memorial to him, was one who built great achievement in his avocations on a quietly constructive career as an educator. His ideas on craft training as developed in the Baron de Hirsch Trade School in New York City, where he served as superintendent from 1894 to 1922, have found valuable application in similar institutions elsewhere. As a designer, he was constantly in demand in the construction of boats and observatories. As an observer of variable stars, he was recognized among other honors by his election to the Royal Astronomical Society. As an authority on dialing, he had no peer in America.

Dr. Yalden had completed the dialing before his death and the design was completed by Mr. Rutherford Boyd. Mr. Frederick Hammargren did a portion of the sculptural execution, while Mr. Robert A. Baillie cut the rest, including the dialing and top, and had charge of the erection.

The squared shaft of the dial itself rises from a massive octagonal pillar modified as a bench, the whole resting on a twenty foot flat base mounted by two low steps. The simplicity of the creation is striking, design being completely subservient to essential function. With elaborate architechtural forms entirely absent, the only decoration is a series of eight life-like carvings of common marine forms on the facets forming the back of the seat.

Time may be read on four vertical faces placed as the sides of a fourteen inch cube. In this, the dial resembles the Bavarian cubical dials of the 18th century, but differs in being surmounted not by a fifth horizontal dial but by a small globe, pierced with an arrow and marked by the meridian hour circles. The structures of brass covered with black baked enamel extending from the four faces are "gnomons." Time is marked by the shadow of the "style," the straight edge of the gnomon, on "substyle lines" on the face. The east face of the dial is marked by these lines in quarter hours from 5:00 to 10:30 A. M.; south from 6:00 A. M. to 5:30 P. M.; west from 1:00 to 7:00 P. M.; north from 4:30 to 7:00 A. M. and 4:30 to 7:00 P. M. All four styles and the arrow piercing the globe are parallel, their inclination to the horizon being an angle equal to the latitude of Woods Hole.

Since standard time for an entire belt of longitude is the "sun time" of a certain meridian, corrections must be made in the readings of ordinary dials not located on the meridian. The engineering of Dr. Yalden produced a dial perfectly adjusted to Woods Hole, corrected to give standard time readings rather than sun time. The correction is most noticeable in an inclination from the vertical of the noon hour line equivalent to the angular distance from the 75 degree meridian.

The only correction then to be made in telling time by the Woods Hole dial is the derivation of "mean standard time" from the "apparent standard time" readings. Due to the orbital motion of the earth about the sun at a constantly varying rate, apparent time and sun time differ by as much as sixteen minutes and coincide around April 15, June 15, August 31 and December 24. A plate containing these corrections throughout the year in chart form is mounted in the stone seat of the dial.

The final tribute to the dialing of Dr. Yalden is the accuracy of the finished monument. Dr. G. H. Parker has checked the dial to a reliability of within half a minute throughout the day.

Plans for the landscaping include gravel walks bordered with blue stone separating four grass plots, the whole surrounded by a square hedge of *Rosa rugosa*.

Sealed in the base of the dial is a large insulated jar, containing various mementos of the time and place, typically publications and pictures.

—*C. P. K.*

The summer meeting of the Genetics Society of America will be held at Woods Hole, August 31 and September 1. On the evening of August 30 a lecture will be delivered by Dr. Boris Ephrussi of the Institut de Biologie Physioco-Chimique, Paris. Two sessions of the program will be devoted to round table conferences on "Different methods of study as applied to problems of genetics; results and purposes. (1) Descriptive methods in development, (2) Methods of experimental morphology, (3) Radiation." These conferences are being organized by Professor L. C. Dunn who will act as leader in the discussions. The different topics will be introduced by: W. Landauer, E. W. Sinnott, H. B. Tuckey, D. F. Poulson, B. Ephrussi, E. Hadorn, M. Demerec and others. One session has been reserved for demonstration papers.

NOTES AND NEWS FROM M. B. L. CLASSES

EMBRYOLOGY CLASS NOTES

Another busy week has gone by and the budding embryologists are taking their last looks at Annelids and Molluscs. Dr. Packard closed his lectures with an interesting talk on the "History of Embryology" starting with Aristotle and following the various trends up to the present day. Dr. Viktor Hamburger spent two lectures discussing the development of and the experimental work done on Annelids and Molluscs. A third was devoted to "The Experimental Analysis of the Development of the Vertebrate Nervous System" based mainly on work done on the frog and chick. Dr. Hamburger himself has done a great deal of work in this field and as a result the talk was of unusual interest. The work of the week closed with the embryology of the squid. The work was somewhat handicapped by the lack of females in captivity. On Monday Dr. G. W. Beadle introduced us to the closely linked field of genetics when he talked on "Genes and the Development of Eye Color in Drosophila."

The annual excursion will have taken place by the time of publication, but at the time of writing it is still a day in the future. A committee consisting of Gene Copeland, Paul Fogel, Charlotte Gross, Barbara Leonard, Arch Logan, Gwen Morgan and Emil Kotcher are in charge of making arrangements. Lobsters and clams promise to make the party a true beach port event, and will give us mid-westerners a taste of real sea food.

—*B. H. L.*

PHYSIOLOGY CLASS NOTES

This week brought us lectures by Dr. Sichel on single muscle fibers and by Dr. Höber on permeability and osmoregulation. Now Dr. Chambers has started on properties of isolated cells and is doing his best to maintain the old Woods Hole custom of informality at lectures, although not quite to Tortugas levels.

In lab Dr. Höber's and Dr. Irving's work continues with new shifts. The CO_2 determiners have decided by now that Van Slyke was a pretty clever little fellow and the cannulators are finding the frog's kidney as tough a proposition as did their predecessors.

Dr. Ohnell has completed his colossal counts on Fundulus eggs and now two more students are watching them with careful eyes. The Warburg apparatus has been placed at the mercy of the gentleman from Virginia and, inasmuch as Dr. Ferguson has been down at Cold Spring Harbor, we fear either little has been done or the apparatus is broken, for the Virginia accent has been much heard on the tennis courts.

—*H. M.*

PROTOZOOLOGY CLASS NOTES

A pure hard flame continues to burn in the protozoology lab. All of the facilities of the village are placed at our disposal and even nature cooperates in our behalf. When electricity fails in all other places it burns brightly for protozoologists. Sunlight and heat are our loyal allies, for they dehydrate protozoa and bathing suits with impartial devotion. Slides, moreover, dry up with astounding rapidity, thereby materially slowing the actions of whizzing little paramecia. God's in his heaven, the snail's on the thorn, and gracious, goodness, what material might be found in that snail!

Dr. Calkins is giving a series of lectures on factors underlying longevity in protozoa. The individual and its daily life was the subject of his talks on July 7th and 12th. Here are involved the relation of the organism to its environment and the whole field of metabolism. We have had a too brief glimpse of the work of Dallinger on temperature adaptation in flagellates and of Loeb and Jennings on the great question of tropisms. Some of the gustatory habits of protozoa have also been reviewed by us. Eight paramecia a day for Didinium and spoonfuls of Halteria for Actinobolina are recommended unreservedly by Dr. Calkins, the man who knows.

Literature on the kinetic elements of flagellates and rhizopods was reviewed by Dr. Kidder in his lecture July 8th. Whether the parabasal bodies in termite flagellates are homologous to Golgi material in metozoan cells; whether or not the parabasal body and other kinetic elements actually have a nuclear origin; the question of universal occurrence of centriolar material; the apparent connection between flagella of Mastigophora and axopodia of Rhizopods; these and other subjects were set before us—a long reach for some of us.

We in protozoology have been pleased to learn that we are not to be held down or in any way inhibited in our desires to follow various interesting lines of endeavor. Of course, as Dr. Kidder says, there are a few minimum requirements that it would be wise to fulfill before branching out too far. As he runs over these briefly, the heart does broad jumps to the pedal extremities and then hops back to clutter up the throat, already stuffed with protozoa. Sticking to the straight and narrow we proceed with staining, and in the course of an afternoon's work are apt to observe an interesting, if not incomprehensible, phenomenon. Frequently, in accord with some personal and ulterior motive, the protozoa have mysteriously disappeared from the slides. Anyone learning of their whereabouts please communicate with members of the protozoology class.

—*M. A. H.*

The Collecting Net

A weekly publication devoted to the scientific work at marine biological laboratories

Edited by Ware Cattell with the assistance of C. P. Kraatz, Anna-Betty Clark, A. S. Cattell and Mary Goffin.

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THE M. B. L. "MESS"

Many people, who continue to eat in the "Mess," have urged THE COLLECTING NET to join in the criticism of the quality of milk and eggs served, the lack of efficiency in kitchen service and the over-working of waiters and waitresses whose only remuneration is board.

Though they may be real, these conditions are only part of the picture. The food is better this summer; the menu has been brightened by fruit each morning, more succulent salads and frequent choices in entrées and deserts. The abundance of good butter and use of fresh vegetables have been meritorious.

Mrs. ("Grammy") Coombs, active after many years of conscientious service, deserves commendation for the manner in which she has been able repeatedly to adjust a system to meet the demands of a growing institution. To feed two hundred people sitting down simultaneously is a major problem.

She will be retiring in the near future and a successor in the job of providing appetizing sustenance at reasonable prices will be chosen. Modern universities give courses, with apprenticeships, in practical dietetics, efficient buying and effective organization. Many individuals so trained serve in educational institutions during the school year and are free in the summer. Their knowledge and experience are available at a relatively low cost. —*C. P. K.*

PARAGRAPHS FROM THE MAIL

"I am much interested in the report in the New York Times of July 11 of the paper presented at Woods Hole by Dr. Oppenheimer and published in "The Collecting Net." Would you kindly send me a copy of the issue containing this report with the bill for the same? B. W. K., Easton, Pa."

"A few days ago I read a very interesting condensation in The New York Times of an article concerning embryonic development which appeared in "The Collecting Net." I am interested in purchasing a copy of the publication referred to and would appreciate complete information pertinent to this end . . . W. T. N., New York."

"I am writing to see if I can get a copy of your publication. I believe it is called *The Casting Net* (Editor's note: italics ours). I wish the current number. From a review I have noted an article in that number which I very much wish to see. I would include price if I knew what it was. G. H. B., Shepherdstown, W. Va."

Introducing

JOHN MACDOUGALD, assistant to the university professor of zoology and comparative anatomy, Trinity College, Dublin, and Rockefeller fellow in experimental cytology.

Dr. Macdougald was born in Dublin, Ireland, in 1912 and was trained in zoology at Trinity College, Dublin, with cytological experience under Dr. J. Brontë Gatenby. His field of investigation was the cytology of tissue cultures, chick and invertebrate. He received the degree of Ph. D. in Dublin University in 1936.

He was awarded the Alexander von Humboldt Stipendium in 1935 and began work in October in the Freiburg laboratory of Dr. Hans Spemann. After four months, he resigned to work in Dr. Albert Fischer's Institute in Copenhagen and also with Dr. Péterfi.

In September, 1936, Dr. Macdougald came to America on a Rockefeller fellowship to work with Dr. Robert Chambers at New York University on the cytology of kidney tissue cultures. The month of May, 1937, was spent at the State University of Iowa investigating with Professor H. W. Beams the effects of ultra-centrifuging on tissue cultures.

He will return directly from Woods Hole to active duty at Trinity College, Dublin, in September.

DR. L. C. DUNN, professor of zoology at Columbia University, stopped at Woods Hole for several days this week. He plans to spend the remainder of the summer at his cottage in Burnham, Maine.

The annual meeting of the M. B. L. Club for the purpose of electing officers for the ensuing year, and the transactions of other business, will be held at the club house Monday, July 19, at 7:00 P. M. W. W. BALLARD, *Sec.*

CURRENTS IN THE HOLE

At the following hours (Daylight Saving Time) the current in the Hole turns to run from Buzzards Bay to Vineyard Sound:

Date	A. M.	P. M.
July 18	1:06	1:15
July 19	1:59	2:01
July 20	2:47	2:49
July 21	3:31	3:39
July 22	4:15	4:17
July 23	4:53	5:02
July 24	5:34	5:43

In each case the current changes approximately six hours later and runs from the Sound to the Bay.

ITEMS OF INTEREST

DR. LAURENCE IRVING, professor of experimental biology at the University of Toronto, has been appointed professor and head of the department of biology at Swarthmore.

DR. RALPH E. CLELAND, formerly professor of biology at Goucher College, is now chairman of the department of biology. He takes the place of PROF. W. H. LONGLEY, who died last March.

DR. KENNETH FISHER, instructor of zoology at the University of Maine, has been appointed assistant professor of experimental biology at the University of Toronto.

DR. OPAL WOLF, who was appointed instructor in biology at Goucher College last summer, has been advanced to assistant professor. She is teaching histology and comparative anatomy.

DR. ARCHIE SOLBERG, fellow in zoology at Columbia University, will hold the position of instructor in zoology at the University of Toledo this Fall.

DR. SAMUEL L. LEONARD, assistant professor of biology at Union College, has accepted a new position in endocrinology under the zoology department of Rutgers University.

DR. R. S. CUNNINGHAM, professor of anatomy at Vanderbilt University Medical School since 1925, has been appointed dean of the Albany Medical College.

DR. B. R. SPEICHER has become instructor in zoology at the University of Maine, and is teaching in its summer school.

DR. ROBERT CHAMBERS of the biology department of New York University has accepted the chairmanship of the executive committee of the Board of Trustees of the Biological Scholarship Association. DR. H. C. BRADLEY, professor of physiological chemistry at the University of Wisconsin and DR. CASWELL GRAVE, Rebstock professor of biology at Washington University, have been added to the Board of Trustees.

MOUNT DESERT ISLAND BIOLOGICAL LABORATORY

(Received July 14, 1937)

With a plentiful supply of dogfish now in Frenchman's Bay, investigators are very busy conducting research on them.

The evening lecture on Tuesday, July 13th, was given by Dr. Earle B. Perkins, Rutgers University, Zoologist of the Second Byrd Antarctic Expedition, on the subject, "Animals of the Antarctic."

Dr. Warren H. Lewis, Carnegie Institution, Baltimore, will present "Motion Pictures of Normal and Malignant Cells" on July 20.

On July 28, Dr. E. K. Marshall, Jr. of Johns Hopkins Medical School will discuss "Sulfanilamide in bacterial chemotherapy."

Dr. Homer W. Smith is engaged in writing, and in correcting proof on his monograph "Physiology of the Kidney" which is to be published by the Oxford Press this fall.

COMMENTS ON THE HIGH SCHOOL BIOLOGY PROJECT EXHIBIT

An exhibit in the Old Lecture Hall of three-dimensional models, photographs, pieces of apparatus and scientific publications assembled by high school students has just been brought to the attention of the workers of the Marine Biological Laboratory.

It is a good omen for the teaching profession, from which all others must arise, when it is so well demonstrated that it is possible to give high school students the stimulation required to produce self-activity of a high order. This is an aspect of teaching frequently discussed but a phase of education as yet only partly realized,—to learn by doing rather than by absorbing. For the latter ends with itself while the former leads to progress. Constructive self-activity of the pupil along the lines shown at the exhibition not only leads to an understanding of phenomena, which cannot be more than vague in two-dimensional print and diagrams, but also stimulates original thought. Since the latter is the first step along the path of research, it seems very fitting that there should be exhibited at Woods Hole for this brief interval a type of activity at the high school level which is the companion and progenitor of research.

Two questions which come to mind are these. To what extent can education of this type be made to reach more pupils? And if it were possible to stimulate a larger number, could their efforts be gradually directed away from the repetitious toward the really creative along biological (rather than technical) lines?

The exhibit which will close Sunday, July 18th, was arranged through the initiative of Miss Lois Hutchings and through the cooperation of Dr. M. H. Jacobs; Professor W. M. Akin, Progressive Education Association; Dr. Otis W. Caldwell, Sponsor, Junior Academics of Science; The New Jersey Science Fair, Trenton; The American Institute, New York; Science Department of The Elizabeth Peabody House, Boston.

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DIRECTORY ADDENDA

Bargeton, D. asst. phys. Univ. of Paris. Br 311. D 318.
Barry, A. grad. asst. biol. Harvard. Br 312. Dr 2.
Bear, R. S. res. asst. zool. Washington (St. Louis). Br 233. D 211.
Bissonnette, T. H. prof. biol. Trinity. OM 28. D 108-9.
Bozler, E. asst. prof. phys. Ohio State. Br 110. MacKenzie, Middle.
Bradley, H. prof. physiol. chem. Wisconsin Med. Br 122A. Juniper Point.
Brisbin, G. W. T. instr. zool. Univ. of Manitoba. L 34. Nickerson, Millfield.
Carothers, Eleanor res. assoc. zool. Iowa. Br 222. Elliot, Center.
Castle, Ruth Montclair State Teachers. OM 29. W E.
Cattell, W. assoc. ed. Scientific Monthly. OM 1. North.
Conklin, E. G. emer. prof. biol. Princeton. Br 321. Buzzards Bay.
Corson, S. A. res. assoc. cell. phys. New York. Br 123. Stokey, Gardner.
Cox, E. H. prof. chem. Swarthmore. Br 110. D 311.
Curwin, Alice O. asst. prof. anat. Women's Med. (Penn.). OM 1. K 2.
Dowding, Grace L. res. asst. anat. Maryland Med. Rock 6. Smith, East.
Du Bois, E. F. prof. med. Cornell Med. Br 301. (Penzance).
Etkins, W. instr. biol. City of New York. L 31. Cassidy, Millfield.
Failla, G. physicist. Memorial Hospital. Br 306. Danchakoff, Minot.
Fien, I. Trinity. OM 28. Dr 6.
Frank, J. A. Yale Med. Br 217f. Swain, Millfield.
Gaylor, J. B. Rockefeller fel. neurol. Johnson Foundation. Br 214. D 315A.
Grand C. G. res. assoc. biol. New York. (Washington Sq.). Br 328c. MacLeish, Millfield.
Hadorn, E. fel. zool. Rockefeller Foundation. Br 311. K 1.
Harman, Doris S. teach. biol. Textile H. S. (N. Y. C.). Bot 2. Nickerson, Millfield.
Henshaw, P. S. biophysicist. Memorial Hospital. (N. Y. C.). Br 343. A 108.
Hershkowitz, S. G. New York Med. OM 25. Cassidy, Millfield.
Hess, W. N. prof. biol. Hamilton. Br 330. A 202.
Hibbard, Hope prof. zool. Oberlin. Br 218. D 213.
Hollaender, A. spec. invest. Wisconsin. Br 344. D 215B.
Hollingsworth, Josephine grad. biol. Pennsylvania. OM Base. W.
Jones, Mrs. Ruth McClung instr. bot. & zool. Swarthmore. Br 9. A 201.
Kaliss, N. grad. asst. zool. Columbia. Br 314. Case, Millfield.
Kindred J. E. assoc. prof. hist. & embr. Virginia Med. Br 106. D 302.
Lichtman, Frieda grad. zool. New York. L 27. Gray, Buzzards Bay.
Maes, J. C. R. B. res. fel. phys. Harvard Med. Br 125. D 310.
Malone, Edna grad. biol. Columbia. L 27. Gray, Buzzards Bay.
Maxwell, Jane instr. biol. Carnegie Inst. Technol. Rock 2. W B.
McClung, C. E. dir. zool. lab. Pennsylvania. Br 219. A 201.
Moore, Caroline grad. zool. Pennsylvania. OM Base. Broderick, North.
Morgan, Isabel M. grad. bact. Pennsylvania. Br 320. Buzzards Bay.
Morgan, T. H. dir. biol. lab. California Inst. Tech. Br 320. Buzzards Bay.
Mundt, G. H. Jr. Amherst. OM Base. K.
Osterhout, W. J. V. mem. Rockefeller Inst. Br 209. MacNaught, Whitman.
Salk, J. New York Med. Br 343. Cassidy, Millfield.
Salomon, K. hon. res. fel. pharmac. Yale. L 21. Coogan, West.
Sauri, H. J. grad. asst. zool. Harvard. OM Base. Frawley, Main.
Sawin, H. J. grad. asst. zool. Harvard. OM Base. Frawley, Main.
Schotté, O. E. asst. prof. biol. Amherst. OM 4. Lehy, Millfield.
Shedlovsky, T. assoc. phys. chem. Rockefeller Inst. Br 209. Wild, Gardiner.
Terni, T. dir. Inst. of Anat. Padua (Italy). Br 310. D 317.
Ting, T. P. Rockefeller fel. biophysics. Johnson Foundation. Pennsylvania. Br 342. Dr 8.
Warner, R. C. res. asst. biochem. New York Med. Br 309. Grinnell, Jr.; North.
Weissenberg, R. W. vis. prof. cytol. Washington (St. Louis). Br 329. Albany, Millfield.
Willier, B. H. head div. biol. sci. Rochester. Br 324. A 301.
Yntema, C. L. inst. anat. Cornell Med. L 33. D 210.
Zarudny, Zoya grad. Museum of Fine Arts (Boston). OM 1. Chambers, Gardiner.

NOTES ON THE ACTIVITIES OF THE M. B. L. CLUB

CHESS

The quiet corners of the club house are likely to harbor one or more games at any time. A number of novices are learning and several experts have appeared. Of these, Theodor Shedlovsky appears to be dean, although serious competition has been offered. Dr. Shedlovsky has offered to meet all comers simultaneously at a public exhibition sometime in late August. Conditions are that each entrant must furnish his own board and pieces. Each must wait until Dr. Shedlovsky comes to his board, then make his move. Further details will be announced later. Why not also a chess tournament?

MUSIC

The concerts are well attended; over 150 people were present last Monday evening. More folding chairs are sought for the Club, since practically all of the floor was used for seating. The program for Monday is: Wieniawski—Violin Concerto No. 2, as played by Jascha Heifetz and the London Symphony Orchestra; Beethoven—Symphony No. 8, played by Serge Koussevitsky and the Boston Symphony Orchestra; and Brahms Symphony No. 1, played by Leopold Stowkowski and the Philadelphia Symphony.

On Wednesday we heard the Kreutzer Sonata of Beethoven, played by Yehudi and Hepzibah Menuhin, and the Bach Suite No. 2 in B minor for flutes and strings.

On any concert evening when a special lecture is announced, the concert will be held immediately after the lecture. —*S. E. H.*

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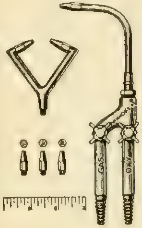

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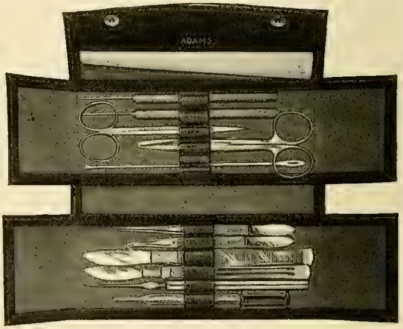

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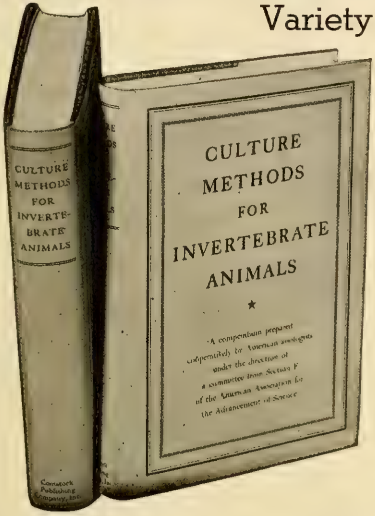
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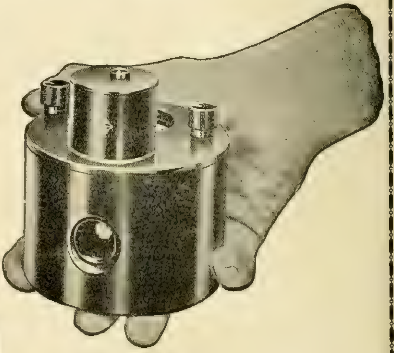

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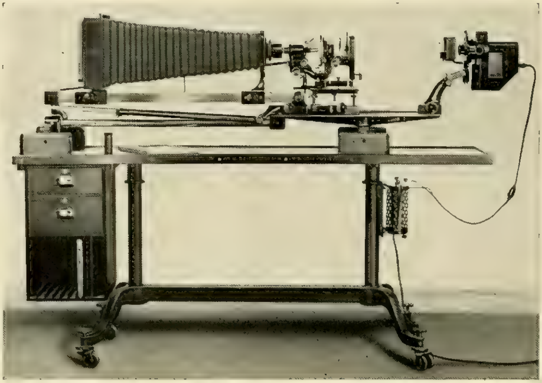

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THE COLLECTING NET

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LIMB BUD TRANSPLANTATION IN CHICK EMBRYOS

Dr. Viktor Hamburger
*Assistant Professor of Zoology,
Washington University*

Wing and hind limb primordia of chick embryos, incubated 2 - 3 days (25 - 30 somites) were transplanted to the lateral trunk region, to the ventral body wall, or into the coelomic cavity of the host embryo. In 137 cases (25%) the transplants developed into limbs of normal shape and of normal or subnormal size.

In the earliest stages used (donors of 25 to 27 somites), the limb primordia were not yet marked off from the neighboring tissue as definite buds. Such primordia, if transplanted to any location of the host embryo developed into typical wings or hind limbs respectively. This shows that the qualities "wing" and "hind limb" and their structural characteristics are definitely determined in the two-day embryo.

In order to find if the *axial pattern* is already determined in these early stages, all transplants taken from donors of 25 - 28 somites (48 - 60 hrs.) were implanted with either (*Continued on page* 83)

M. B. L. Calendar

TUESDAY, July 27, 8:00 P. M.

Seminar: Dr. J. K. W. Ferguson and Dr. F. A. Hitchcock: "The Effect of Standing on the Carbon Dioxide Content of Alveolar Air and Total Ventilation in Volume."

Dr. Eugene F. DuBois and Dr. James D. Hardy: "The Mechanism of the Loss of Heat from the Human Body."

Dr. Emil Bozler: "Peripheral Inhibition of Smooth Muscle."

Drs. W. R. Amberson, T. P. Nash, A. G. Mulder and Miss D. Binns: "The Relationship of Tissue Chloride to Plasma Chloride."

FRIDAY, July 30, 8:00 P. M.

Lecture: Professor Caswell Grave: "Metamorphosis in Ascidians."

OVULATION IN MAMMALS AND INTERNAL SECRETIONS INVOLVED

Dr. Edgar Allen
*Professor of Anatomy,
Yale University Medical School*

Slides of various mammalian ovaries—mouse, dog, rat, ferret, monkey, and human—show the formation of new eggs in the adult ovary, the elimination of many eggs even in the late stages of development, the process leading to the escape of the ovum from its attachment to the wall of the follicle, the growth (cell division) of follicle cells apparently under some influence from the egg, the final rupture of the follicle, and the early development of the corpus luteum.

The follicular hormone and the corpus luteum hormone of the ovary have certain reactions on the vagina, uterus and mammary glands. As concerns the last point, the application of a new drug to the study of growth has greatly clarified the influence of these hormones. This drug, colchicine, in the proper dosage, has the ability to stop dividing cells in metaphase. It makes it possible, therefore, to accumulate all the cells which have divided in the last 9-18 hours and hold them in an

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Photographs by Fred S. Howard

easily recognizable condition for counting. This makes it possible to observe growth in tissues where it has previously been difficult to find it because it is either so slow or so difficult to ascertain the time for optimum growth.

As to the mechanism of the menstrual cycle, regular menstruation may occur without ovulation; menstruation can be produced experimentally in monkeys and women after the ovaries have been removed by injections of the follicular hormone alone; menstrual periods of any desired length can be produced in this way; the uterus can be kept growing for as long as a year without menstruation if the follicular hormone is injected in large enough amounts. The significance of menstruation as a degenerative process, a rest from growth, is suggested as an interpretation of this phenomenon.

Remarkable activity is displayed in the egg and in the follicle during the few hours preceding rupture. Moving pictures show that ovulation in the rabbit is a sudden process, quite explosive in nature. The follicle bulges from the surface, intrafollicular pressure constricts the capillaries and produces a small avascular spot on the follicle wall; this greatly weakened spot "blows out a pimple," a slight leakage of the more fluid contents of the follicle occurs, and then the more viscous follicular contents are extruded suddenly; slight bleeding usually occurs at this time.

After the moving picture revealed the sudden nature of ovulation, a search for change in electrical potential at the time of ovulation was made with a very sensitive electrical potentiometer developed by Burr. With one electrode in the vagina and the second on the symphysis pubis of a rabbit deeply anesthetized, it was found that at the time of ovulation a decided rise in electrical potential occurs. This was recorded at the time rupture of the follicle was observed and it was seen that the rise in potential paralleled the rapid increase in size of the follicle and that immediately after rupture the potential dropped. With this method it is possible to tell in the intact animal the exact time of rupture of each individual follicle. It is hoped that with the application of this new technique it might be possible to obtain additional evidence as to the time of ovulation in the menstrual cycle in women. The importance of the application of this to contraception and to increase in fertility can readily be appreciated.

(This article is based upon an evening lecture presented at the Marine Biological Laboratory on July 21).

LIMB BUD TRANSPLANTATION IN CHICK EMBRYOS

(Continued from page 81)

their anterior - posterior axis or their dorso - ventral axis, or both axes inverted with respect to the axes of the host. In every single case (25 cases of successful wing bud transplantations and 25 cases of successful hind limb transplantations) the transplant retained exactly the orientation given it at operation; it was not influenced at all by the axial pattern of the host. This result shows conclusively that the anterior - posterior and the dorso-ventral axes are fixed at the time of operation. If the axis determination of the chicken limb bud proceeds in the same step by step sequence as was found by Harrison and others in Amblystoma, the crucial stages for dorso - ventral determination must be earlier than in the 25 somite embryo.

Special attention was paid to the *innervation* of the transplants. Those located far ventrally were nerveless, as sections showed; it is assumed that also the transplants grafted into the coelom are not innervated, since they are only loosely attached to the mesenteries, did not show motility in life and their musculature appeared atrophic. Such nerveless limbs were normal in shape and, as preliminary histological observations showed, the structure of the cartilage, including the joints as well as the differentiation of the musculature, was normal; few signs of degeneration of the musculature were found. We conclude that the innervation and, consequently, the functional activity, are not essential factors in the development of the limbs, at least not in their early phases up to 10 - 12 days of incubation.

Transplants located near the spinal cord were supplied by trunk nerves or by nerves branching from the brachial or from the lumbosacral plexus of the host. Of special interest is the reaction of the central nervous system of the host to this peripheral overloading. The spinal ganglia reacted always to even small increase in their peripheral fields by hyperplastic growth. The ganglia of the

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MEMBERS OF THE PROTOZOOLOGY AND PHYSIOLOGY CLASSES OF THE M. B. L.

First row, left to right: Mrs. Elizabeth D. Hughes, J. Loukides, M. Brooke, V. Dropkin, A. Schlossman, J. Caldwell, J. Meigs. **Second row,** Dr. G. N. Calkins, Ida Chasnoff, Hester Snider, Susan Green, M. Katherine Gurley, Barbara Noyes. **Third row:** Dr. G. W. Kidder, Mary Alice Hartwell, Elizabeth White, Muriel Voter, Esther Fippinger, Jane Belcher.

First row, left to right: E. Black, E. Hiatt, L. Ravitz, W. Grant, Dr. P. Dugal. **Second row:** Jane Bridgman, Barbara Lambert, Margaret Huntington, Mrs. R. Höber, V. Safford, Elizabeth W. Smith, Sarah Culbreth, Dr. L. Irving. **Third row:** E. Fetcher, Dr. C. L. Prosser, C. Hock, Dr. K. C. Fisher, J. Patterson, Dr. J. A. C. Cameron, Dr. R. Höber, D. Evans, Dr. J. K. W. Ferguson.

left side gave a convenient control. In several cases, the motor neurones of the lateral motor column of the spinal cord were counted in the segments supplying the transplant with motor fibers, in adjacent levels and the figures for left and right side were compared. A marked hyperplasia was found in 4 out of 7 cases, ranging from 14% - 30% for the innervating segments. It is evident that the growth of both sensory and motor centers in the spinal cord is not purely autonomous but is controlled in a quantitative way by the peripheral fields to be innervated.

(This article is based on a seminar report given at the Marine Biological Laboratory on July 20).

THE ACTION OF ORGANIZERS ON ADULT TISSUES

Dr. O. E. Schotté

Assistant Professor of Biology, Amherst College

Experimental embryology has shown that, at least in the vertebrate embryo, the first stages of development follow a rather flexible pattern until the axial systems are indicated and the general form of the embryo has been achieved. During this time the flexibility of the developmental patterns has been demonstrated by various methods, among which the action of organizers has produced the most spectacular results.

But later when organogenesis accompanied by histogenesis begins, more rigid developmental processes confer on the embryo a one-way direction of differentiation from which there is no returning. The embryo is then said to be determined and "determination" is considered a final and irreversible step of development.

Yet the facts of the regeneration of limbs in amphibians have shown that regulative adjustments are by no means precluded after the end of the embryonic period, as these morphogenetic processes continue even in the adult.

The phenomena of normal regeneration and especially the results of the transplantation of young regenerating blastemas indicate clearly that normally regenerating tissues receive their differentiation from the surface of amputation which, as many experiments have clearly shown, must be considered as a morphogenetic "field." Thus the morphogenesis of regenerates can be compared to a process of induction similar to those demonstrated by many experiments in the embryo.

If this is true, then regenerating tissues should be capable of showing actual totipotency if submitted to the action of organizers.

In order to test this supposition, regenerating blastemas of eye and tail of adult newts and tail blastemas of old tadpoles have been implanted on an eye or into the eye chamber of adult newts or old tadpoles, from which the lens has been previously removed.

It could be shown in many cases that the mesenchyme of both eye and tail blastemas is transformed under the influence of the new inductor into morphologically and histologically well conformed crystalline lenses.

In order to further test the lens-forming potencies of the regenerating mesenchyme, embryonic eye-cups (Harrison stage 27-28) have been implanted beneath the skin of regenerating tails of *Rana pipiens*. This embryonic eye induced not only violent proliferation processes in the mesenchyme but also far reaching processes of induction; not only lenses, but also ear vesicles (with endolymphatic canal), nose vesicles and mouth cavities have been observed to develop inside of this regenerating tissue of the tail.

Induction in regenerates shows thus much more extensive effects than those which so far have been observed in embryonic induction. The fact that ear, nose and mouth are induced under the influence of an embryonic eye-cup is tentatively interpreted in the following way: the eye-cup induces a lens and, with the surrounding tissues, a morphogenetic "eye-field" is established. If the regeneration processes were to stop here no further effects would be observed, but as proliferation continues, the new cellular material becomes submitted to the action of the eye-field and a neighboring morphogenetic field, say "ear" or "nose" field is thus created. Eventually a more generalized "upper head" field becomes established which can now exert its influence on the available mass of undifferentiated tissue in creating a "lower head" field—a mouth cavity.

It can be concluded from this research that regenerating mesenchyme of adult amphibians is really totipotent as it manifests properties similar to those of the embryonic ectoderm of amphibians before gastrulation. "Embryonic" induction is possible also in adults, a development which is very much in accord with the views on differentiation and on "determination" which Ross G. Harrison has expressed long ago.

(This article is based on a seminar report given at the Marine Biological Laboratory on July 20).

THE COLLECTING NET has been entered as second-class matter July 11, 1935, at the Post Office at Woods Hole, Massachusetts, under the Act of March 3, 1879. It is devoted to the scientific work at marine biological laboratories. It is published weekly for ten weeks between June 1 and September 15 from Woods Hole and printed at The Darwin Press, New Bedford. Its editorial offices are situated on the third floor of the Woods Hole station of the United States Bureau of Fisheries. Between June 1 and October 1 communications should be addressed to Woods Hole, Massachusetts; at other times they should be directed to THE COLLECTING NET, Garrison, N. Y. Single copies cost 30c; a subscription (containing not less than 280 pages) costs $2.00.

CHEMICAL STIMULATION OF THE AMPHIBIAN ECTODERM

Dr. L. G. Barth

Assistant Professor of Zoology, Columbia University

Three years ago the writer reported that cephalin acted on the ectoderm of the amphibian gastrula to produce neural plates. In the last three years several agents have been suggested as organizers. Waddington and Needham have been using a preparation which is precipitated by digitonin; while Fischer and Wehmeier have reported neural plates with a variety of substances which have been acidified. Until recently, investigators have sought for a specific substance which would stimulate the formation of the primitive nervous system. My own experiments show clearly that the formation of a neural plate is due to some general stimulus imparted to the cells and this stimulus may be provided by a variety of substances.

In the early experiments with cephalin I found that the cells coming in contact with the substance often cytolysed. Only in a few cases were neural tubes induced. Therefore, I tried cytolytic agents such as digitonin, acids and bases and found that, by regulating the concentration so that death of the cells did not occur, neural plates could be induced. Using powdered egg albumen as a carrier, .1 to .05% digitonin forms a good inducing agent in *Ambystoma mexicanum*. Buffers at pH 3 and 10 are also effective but harder to control. Often the embryos die.

Naturally the fact that several unallied chemical compounds will act as stimulating agents makes the problem of the natural stimulus during gastrulation more complicated. Much has been said of the ether solubility of the organizer without regard for the facts of the case. The facts are that after prolonged extraction with hot fat solvents the protein residue is much more effective than the extract. One experiment will be cited. A sample of calves' brain was extracted with acetone, alcohol and ether and the fine powder divided into two lots. One lot was treated with pepsin-HCl to partially hydrolyse the proteins to free bound lipids. It was then extracted with alcohol and ether and a small quantity of lipid recovered. This preparation is very weak in stimulating neural plates. The second lot was further refluxed with hot alcohol and warm ether for 24 hours and the residue tested. Neural tubes as good in appearance as those of the host were obtained. Holtfreter earlier pointed out that after treatment with alcohol and ether, tissue was a *better* organizer than before. It is incongruous then to emphasize the ether solubility of the organizer when the facts point in the opposite direction.

I have only begun experiments involving protein extracts. An alkaline extract of the protein residue produces large outgrowths of the ectoderm but no organization into neural plates or tubes. This fraction apparently contains only a growth-stimulating factor.

(This article is based on a seminar report given at the Marine Biological Laboratory on July 20).

NOTES AND NEWS FROM M. B. L. CLASSES

PROTOZOOLOGY CLASS NOTES

Dr. and Mrs. Calkins entertained the protozoology class and friends of the class at a tea in their home Sunday afternoon. Mrs. Kidder and Mrs. Hughes assisted at the urn and a terrestrial form of deck tennis was enjoyed on the lawn. A good time was had by all.

Dr. Calkins continued his series of lectures on longevity when he spoke, July 16th, on the great question of natural death in protozoa. Weismann's theory, that death is only a penalty of specialization and does not occur in protozoa, was reviewed. Maupas, who kept protozoa on slides and isolated the progeny, was the first person actually to test this theory by experimental work. His results, although severely criticized, gave evidence that Weismann had been wrong, for after eight or nine months the protozoa died. Maupas' methods were used by subsequent investigators whose results also were opposed to Weismann's theory that protozoa never die. Still, the critics held, being kept under a cover glass was an abnormal environment for these animals and the results were not necessarily correct. In 1919 Professor Calkins used a refinement of this method to test the longevity of *Uroleptus mobilis*. By transferring one animal daily to a drop of medium in a dish, he was able to keep lines for two years or 720 generations. Ultimately, however, these animals would die, and gave good evidence that reorganization by division was not sufficient to keep the race going indefinitely.

As a result of this work, Dr. Calkins has been able to show that in the life of each of these bits of protoplasm there is a distinct curve of vitality. The curve begins with the young, newly conjugated individual and ends with the slowing down and death of the line. Vitality, according to Dr. Calkins, is measured by the frequency of division of the protozoan. We wonder whether vitality in *Homo sapiens* might be assayed by a course in protozoology.

Dr. Kidder lectured July 15th on mitochondria and golgi bodies, and July 20th on parasitism, commensalism and symbiosis. After much exposure to popular literature on termite flagellates we were very glad to learn the whole truth about their cellulose eating capacity.

A fantastic and unbelievable event occurred one day this week, when our esteemed faculty were witnessed trying to lure all members of the class *out* of the lab. The only poor excuse which they had to offer for this heresy was a proposed class photograph. Subsequent events indicated that the whole thing was a mistake. At least, the developed picture is a fixed and stained preparation by which posterity may determine the effect of protozoology on external appearance. —*M. A. H.*

EMBRYOLOGY CLASS NOTES

The effects of the class excursion are still being felt by the majority of the class but notwithstanding the affair was a tremendous success. An anxious day preceeded the picnic as unfavorable weather was prophesied for the occasion, nevertheless fate finally decided to smile on us, and Tuesday dawned cloudy but dry. The water was quite choppy and the sea-legs of some were rather unsteady, yet the "ill feeling" was forgotten by those on the *Nereis* as they paused to drag for sand dollars. The *Winifred* and its cargo of food were waiting when the *Nereis* came into Tarpaulin Cove and no time was lost getting started. The lobsters called for much concentration from the consumers, as photographs readily show, and Dr. Goodrich was kept busy "dissecting" lobsters for those new to the technique. After lunch, swimming, baseball, hiking, touch football, tree-climbing and other strenuous sports kept the class in motion. Yet, in spite of the holiday, the scientific urge got the better of us, and a luckless Limulus was the object of much experimentation until kind-hearted Doris Hamburger rescued it from its tormenters and returned it to its habitat. Coming home the spray dashed over the bow of the ship and drenched all in its path, stinging our faces but not dampening our ardor. We were a bit sorry when we reached the quieter waters of the bay for it meant that our day of "rest" was over.

The following day we took our wearied and weatherbeaten bodies back to lab to start work on echinoderms. Dr. Schotté started us with lectures on normal development and metamorphosis. Dr. Chambers spoke to us on fertilization in echinoderms, giving us further information to aid in our laboratory work. Dr. Willier gave us a brief respite from echinoderms when he talked on "Hormone Control of Sex Differentiation in the Chick." Since Saturday we have been trying to fool Nature by producing fatherless sea urchins, but for most of us Nature refuses to be fooled. But just wait! Dr. Schotté says it can be done. —*B. H. L.*

PHYSIOLOGY CLASS NOTES

Well—we had our picnic and what an outing it turned out to be! Plenty of food, plenty of drink, plenty of sand, plenty of sea—and adventure all over the place.

The day was perfect! Hiatt had ordered it from his uncle who is a weatherman, and so we started forth with hope in our hearts and beer in the hold. Little did we think that before the blazing sun would have hidden its face again, stirring events would create mighty heroes, whose valiant deeds will go down recorded in M. B. L. history.

Even before we left the Woods Hole dock there were rumblings of future excitement. Our boat, the *Winifred,* would go in only one direction, no reverse possible. We decided that merely meant no turning back now. So off we went anyway on a fine ride down Vineyard Sound to the tip of Naushon. There one-third of our party disembarked and walked back to Tarpaulin Cove, arriving just in time for the sumptuous feast Mr. Smith had helped us prepare. We ate all we could, saving the remains for the few who were expected to stay out another meal. The excess consumption was worked off in various ways, baseball, mumble-peg, leisurely conversation and, from a few, lusty snores. Then came a long swim with a diving board rigged up on the boat and at last the curfew blew.

We thought that all but the hardiest and most adventurous were loaded aboard, those few being left to walk the 7 miles back to Nonamesset, but it soon appeared that hardiness and love of adventure were to be best exhibited by those on the ship. Let an eye-witness tell the story in her own words.

"Hardly had the hikers disappeared into the wood-ticked forest than a vague uneasiness seized the passengers. The boat was not moving! Only a faint spluttering was heard, whether from engine or engineer being undetermined. Patiently the physiologists waited for an hour or so until some of the more curious paid a visit to the engine room. On return they reported that there did indeed seem to be some kind of trouble. The captain had the whole engine apart and his watch as well and couldn't put either of them back together again. And the captain didn't lower the anchor and the ship didn't know it shouldn't drift upon the rocks. Crunch! Crash! Brave looks were on the faces of those sure they were about to be shipwrecked with furtive glances toward the life preservers. Only the heroic calmness of Red Ed saved us from wild hysteria.

"After everyone aboard had volunteered suggestions it was decided to try to *row* the boat off the rocks. Alas! we had lost the oarlocks of one rowboat, but four stalwarts entered the other, breaking one boathook in the process and inadvertently letting the other slip out to sea. This left the score:—2 oarlocks, no boathooks, 1 engine all in pieces, 1 watch all in pieces, 1 befuddled captain and 1 boat on the rocks.

"Our Four Oarsmen of the Apocalypse now showed themselves to be rugged individualists, each rowing in a different direction, and the boat went round and round. Then the gallant Dr. Cole came to the rescue. With lusty lungs he synchronized the rowing and immediately the boat shot forward pulling the *Winifred* after it. Once in deep water again, the anchor was lowered and the oarsmen started rowing for the lighthouse to telephone Woods Hole for help. Just as they reached shore the engine gave an apologetic cough and started to chug away merrily. With much effort the anchor was lifted, and just as it landed on the deck, the engine stopped again! Down went the anchor! Up started the engine! Up the anchor and down the engine! So the game continued for two long hours.

"At this point the children accurately diagnosed the situation by discovering that everyone was hungry. Dr. Amberson somehow found the weenies the hikers had carefully reserved for the end of their long walk and these were boiled in the coffee pot and consumed along with almost everything else so that when the *Nereis* finally came to the rescue and towed us home, there was very little to put ashore on Nonamesset for the tired and hungry trampers."

They had had a fine walk, but at a ferocious pace set by Laurence Cunningham Irving. There was one casualty in the form of a sprained ankle for the Kansas Star but this netted her a buggy ride with a real honest-to-goodness coachman and some noble carrying on the part of Dr. Ferguson *et al.*

Nor was the evening spoiled by the late arrival of very little food. Those who stayed around the fire on Nonamesset until the long hours of the clock will never forget how Dr. Chamber's voice changed from base to tenor, nor the expertly harmonized and syncopated version of "Show Me the Way to Go Home" as given by Chambers, Hiatt, Irving, and Cole.

As for the rest who had so closely escaped shipwreck and the briny deep, they arrived home at 9:30, all feeling entitled to the Carnegie Medal for bravery, and agreeing with Mrs. Höber when she exclaimed "This day has brought more adventure than seven trips across the Atlantic."

—*M. H.*

SHARK KILLED IN HADLEY HARBOR

A 30-foot shark, which had presumably made several appearances in the neighborhood of Woods Hole in the two days previous, was killed by a bullet in Hadley Harbor on Saturday afternoon, July 17th. The first indication of the marine visitor occurred on Thursday when some fish traps in Buzzards Bay were found slashed with huge rents. Twice on Saturday morning a large animal was reported off the Breakwater Beach, the U. S. Bureau of Fisheries being called at five o'clock with a request for someone with a rifle.

The shark was however sighted off Naushon Island on Saturday afternoon, nearly causing a grocery delivery boat to be capsized as the driver tried to avoid a collision. An expedition from the island fired several shots into the animal and it was towed near the shore where it was finally dispatched.

A group from the Bureau of Fisheries which had been offered the carcass went over and made measurements on Sunday morning as the body rested in about two feet of water. An attempt was made by Dr. A. A. Abramowitz to dissect out the pituitary gland with an ax, but immersion made the operation difficult, and he returned to Woods Hole without it. Pictures made by another group, including Dr. G. H. Parker and Dr. B. H. Goodrich, will be printed in The Collecting Net. The body was towed out and released off East Chop on Sunday afternoon, to the dismay of a number of Woods Hole people who had planned a trip to Hadley Harbor for low tide Sunday evening.

The shark, identified as a basking shark by the Bureau of Fisheries (*Cetorhinus maximus, Gunner*), used to be seen frequently in the Woods Hole region, but, according to Dr. P. S. Galtsoff of the Bureau of Fisheries, this is the first specimen reported since 1920. These animals are harmless to human beings and live entirely on small pelagic crustaceans. Although the liver is very valuable for oil, that of the local specimen was not saved.

Measurements by Dr. Galtsoff showed a length from the tip of the nose to the tip of the dorsal lobe of the tail fin of 29 feet 2 inches; depth of the body at the insertion of the dorsal fin of 5 feet 9 inches and circumference at the same level of 14 feet 6 inches. The weight was estimated to be from four to six tons. The numerous teeth were very small, extending but a few millimeters from the jaw.

The Bay Shore bath house, property of the M. B. L. through the recent generosity of Dr. Edward B. Meigs, is open to use by investigators and students of the Woods Hole Laboratories through rental of rooms.

NOTES ON THE ACTIVITIES OF THE M. B. L. CLUB

At the annual meeting of the club, held according to the constitution on the third Monday in July, the following officers were elected: Samuel E. Hill, president; J. K. W. Ferguson, vice-president; W. W. Ballard, secretary-treasurer; Charles Packard, trustee of the class of 1940 to replace L. V. Heilbrunn, class of 1937. Dr. Jacobs reappointed trustee P. B. Armstrong, class of 1937, to the class of 1940.

The treasurer's report showed the club's finances to be in a satisfactory condition, with the largest surplus in several years, but also with a large outstanding debt for the re-roofing and leveling of the club house. A recommendation was made and carried by vote of the club that the executive committee expend the surplus as it sees fit in the interests of the club. A portion will probably be voted to the trustees for reducing the club's indebtedness and the remainder used for additional needed repairs to the club.

MUSIC

On Monday, July 26, we will hear the Brandenburg Concerto No. 6 of Bach, and Beethoven's Symphony No. 9 (Choral) as played by Leopold Stokowski and the Philadelphia Symphony Orchestra. On Wednesday, July 28, we will hear the Beethoven Quartet in F major, Op. 135, as played by the Lener String Quartet, and Bach's "Well Tempered Clavichord, No. 1 to 9," played by Harold Samuels.

The music committee has borrowed 13 additional folding chairs for the concerts and will borrow more if and when they can be found.

The concert scheduled for Wednesday, Aug. 4, will be postponed until a later date as a courtesy to The Collecting Net Scholarship Association Concert by the Women's Symphony Orchestra of Boston.

CHESS

Dr. Theodor Shedlovsky has been appointed chairman of the chess committee and will direct the rooks and pawns for the balance of the season.

INVERTEBRATE MIXER

The second mixer will be held on Saturday, July 31, at the M. B. L. Club at 8:30 P. M. The committee anticipates a large and enthusiastic turnout. Conversation and cookies will be followed by dancing as soon as the crowd thins out sufficiently. The famous figures in biology are particularly urged to be present. No youngster will ever forget his first thrill on seeing a Parker, a Morgan, or a Conklin. —*Anonymous*

THE M. B. L. TENNIS CLUB

The M. B. L. Tennis Club tournaments will begin the latter part of this week, starting with the mixed doubles tournament. The trophy for this tournament was donated in 1921 by Dr. Strong and in that year was won by Dr. and Mrs. C. C. Speidel. The semifinal and final matches of this tournament will be played on Friday and Saturday of next week.

Entry lists for the other tournaments are posted near the clay court. There will be semifinal and final matches every Friday and Saturday through August 21st, the day of the men's singles final match. The schedule follows: mixed doubles, July 30, 31; women's doubles, Aug. 6, 7; men's doubles, Aug. 13, 14; women's singles, Aug. 19, 20; men's singles, Aug. 20, 21. The time and place of various preliminary matches will be posted by the contestants on the tournament card. For the semifinal and final matches, which are to be played on the clay court, the tennis club will reserve certain hours and for the final matches will provide an umpire and linesmen.

In addition to the tournaments for adult members of the tennis club, there will be two tournaments for junior members. The suggestion for this was made by Mr. L. Saunders. Mrs. H. W. Stunkard has consented to be chairman of the committee to organize these tournaments. All eligible junior members should sign their name and age on entry sheet at the clay court or inform Mrs. Stunkard. Mr. and Mrs. Saunders are donating a cup to be retained by the M. B. L. Tennis Club but which will have engraved on it the names of the winners each year of the junior and children's divisions. In addition they are going to present each winner with a trophy. These tournaments are open to children of 14 years and under who are members of the M. B. L. Tennis Club. All matches are to be played on the colas courts except the semifinal and final matches which may precede the men's doubles matches on August 13 and 14.

The number of tennis club members has gone well over the 100 mark and congestion, particularly on the clay court, is a very serious problem. While some members are leaving Woods Hole, the half-season memberships are available after July 26th and it is expected that the final membership list will number over 150. The half-season rates are: full membership $3.50, colas membership $2.50.

Flood lighting of the clay court has been considered, but the initial expense of installation of lighting equipment would be about $250.00 and the consumption of electricity would cost about 25c per hour. The tennis club committee is very anxious to secure additional property on which to build clay courts. At present it is difficult to reserve the clay court for more than one hour in five days and, with two additional courts, playing facilities would be adequate to meet present demands. *Roberts Rugh, President*

NOTES FROM THE TROUT LAKE LIMNOLOGICAL LABORATORY

C. JUDAY, *Director*

The Trout Lake Limnological Laboratory has begun its thirteenth summer research work on the lakes of northeastern Wisconsin. The staff consists of twenty-two investigators and assistants who are engaged in studies that include problems relating to the geology, the physics, the chemistry and the biology of the various types of lakes that are found in the district. The general plan of the present investigations is similar to that of previous years, with special emphasis being placed on certain phases of the work which were not investigated in former years.

Dr. Z. Kozminski of the Polish Biological Station located on Lake Wigry is spending the summer at the Trout Lake Laboratory. He is making a special study of the chlorophyll content of the phytoplankton by means of a Photelometer. His investigations also include the taxonomy, the distribution and the ecology of the copepods belonging to the genus Cyclops that are found in the different types of lakes and lakelets of the region.

Dr. G. W. Prescott of Albion College is continuing his studies of the taxonomy and ecology of the algae of the lake district. In late July he will go to Woods Hole for the second half of the summer.

Dr. L. V. Whitney of the Laboratory staff is engaged in securing continuous records of the amount of solar radiation that is delivered to the surfaces of the lakes and also the amount that penetrates to the various depths in different types of lake waters; a Cambridge recorder is used for the subaqueous readings of solar energy. Dr. Whitney is also making a study of the microstratification of the water in the thermocline and the hypolimnion of several lakes by means of a photoelectric transparency meter.

Dr. Minna E. Jewell of Thornton Junior College, Harvey, Illinois, is continuing her studies of the freshwater sponges. She is investigating the effect of several environmental factors upon the growth of these organisms; special attention will be given to the effect of light.

Dr. W. M. Manning of the Laboratory staff is making further studies of the photosynthesis of plankton algae and of the large aquatic plants; a special effort is being made to work out more thoroughly the problem of quantum efficiency.

Dr. Edward Schneberger of the Wisconsin Conservation Department is carrying on investigations relating to the survival of fish fry that are planted in lakes and to other fish problems that have a scientific as well as a practical value.

DEPARTMENT OF PUBLICATIONS

THE BOOK OF THE SEASHORE: by Howard J. Shannon. 281 pages and 50 pages of half-tone illustrations by the author. Doubleday, Doran & Co., Inc., 1935.

This description, not from the point of view of the scientist, but from that of the observant layman, is of life on the beaches of southern Long Island. For a quarter of a century the author has watched. There is a general thread running through the whole description, of the stark struggle for existence against great odds so that only those plants, insects and birds remain which have found some kind of solution. For instance, the burrowing wasps, fruitlessly trying to dig in the ever shifting sands, finally manage to make a stable burrow among plant roots. The plants are sharply selected so that water saving devices are the rule; the larger plants, trees, show in their gale-twisted forms some of the difficulties they have endured—and incidentally remind us in Woods Hole of the gnarled and wind-razed trees of Naushon.

Then philosophizing on the causes back of what he sees upon the beach today, and speculating as to the future of the now-surviving forms, he looks back into geological history and, guided by fossil records of the region, paints fanciful pictures of the tropical vegetation of Cretaceous times.

There is a chapter upon sand tracks of creatures such as the sandpiper, the gull, the crow, the crab, beach rats, snakes and beetles. Another section is on seasonal changes including some very interesting reports of migrations, particularly of dragon-flies and monarch butterflies.

The final chapter in the book is not about the living forms, but about the earth itself. Is the coastline changing? the sea encroaching? Apparently yes, just as on Martha's Vineyard, Nantucket and Cape Cod the coast is wearing away in spots. Reference is made to the fact that of 10 acres of land acquired by the government in 1797 for the Highland Light site, only 5 acres now remain. And the book ends on a nostalgic note of fear that the very existence of the beaches and their life, so sympathetically described, is threatened by man's cheap invasions.

—*Hope Hibbard*

The Collecting Net

A weekly publication devoted to the scientific work at marine biological laboratories

Edited by Ware Cattell with the assistance of C. P. Kraatz, Anna-Betty Clark, A. S. Cattell and Mary Goffin.

Entered as second-class matter July 11, 1935, at the U. S. Post Office at Woods Hole, Massachusetts, under the Act of March 3, 1879.

SCHOLARSHIPS AGAIN

Plans for the scholarship program of The Collecting Net are shaping themselves in an interesting fashion. An organization has been formed known as "The Collecting Net Scholarship Association,"* its purpose being to place the scholarships sponsored by the journal on a firmer foundation and to expand its activities in this direction. The Association hopes to be able to collect sufficient money to award several one-hundred-dollar scholarships to students who by their work during the present summer have shown their aptitude for research. The money would be used in assisting young investigators to meet their expenses during the summer of 1938 at one of the summer marine laboratories.

At present the plan is to give scholarships to the biological laboratories at Cold Spring Harbor and Mount Desert Island as well as at Woods Hole. In this cooperative enterprise it is assumed that the other laboratories will assist with the work of the Association; that is, if an annual scholarship is to be given to Cold Spring and Mount Desert, these communities should be represented by some twenty members each.

Every biologist interested in the work of the Association could well join. We anticipate, however, that fully half the money will come from those individuals who are interested in biology, but who are not themselves biologists. The full amount received in annual dues will go towards scholarships because The Collecting Net has undertaken to meet every expense of the Association.

Plans for a marine biological laboratory on the South side of Pivers Island at Beaufort, N. C., are being perfected by Drs. R. L. Flowers and A. S. Pearse of Duke University. Ten single story frame buildings will be constructed including two laboratory buildings, four dormitories, a lecture hall and a mess hall. The Duke Marine Laboratory will accommodate approximately 40 scientific workers when it is complete.

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* Formerly announced as the Biological Scholarship Association.

Introducing

Tullio Terni, chairman of the department of anatomy, histology, and embryology of Padua Medical College, Italy and special fellow of the Rockefeller Foundation.

Dr. Terni was born in Livorno, Italy, in 1888. He studied under the anatomist, Professor G. Chiarugi, at the University of Florence. After completing his graduate work, he became lecturer in the department of Dr. G. Levi at Turin University. He later studied at the Kaiser Wilhelm Institut under Dr. Mangold and Dr. Péterfi, and in 1925 was appointed chairman at Padua Medical College.

His publications have been in the field of experimental cytology, embryology and neuro-anatomy. As a result of his researches, he was awarded membership in the Italian National Council of Research, the Royal Academy of Lincei, the German Society of Anatomists, the French Association of Anatomists, the International Institute of Embryology and other societies.

Dr. Terni arrived in the United States on July 8 and plans to spend the summer at Woods Hole working with Dr. Robert Chambers on the micro-dissection and biology of spermatozoa, and the movements of flagellated and ciliated cells. In the fall he will go to the Rockefeller Institute for Medical Research to work with Dr. Alexis Carrel on the fertilization in vitro of somatic cells, especially fibroblasts.

Before his return to Italy Dr. Terni plans to visit and study on behalf of the Italian National Council of Research the organization of the chief biological centers of the United States.

ADDITIONAL INVESTIGATORS

Co Tui, F. assoc. prof. expt. surg. New York. Br 343. D 111.
Coonfield, B. R. asst. prof. biol. Brooklyn. OM 39. D 24.
Crystal, S. res. asst. Rockefeller Inst. Br 206. Berg, High.
Dorris, Frances res. asst. embr. Yale. Br 8c. Stevenson, School.
Dugal, P. instr. biol. Montreal. Br 107. Nickerson, Millfield.
Foerster, J. Washington Med. (St. Louis). Br 233. Röhmeling, Pleasant.
Jones, E. R., Jr. assoc. prof. biol. William and Mary. Savery, Main.
Marshak, A. phys. Deaconess Hospital (Boston). Br 304. Stevenson, School.
Northrop, J. H. mem. Rockefeller Inst. Br 206. (Cataumet).
Rubin, S. asst. med. New York. Br 309. Millfield.
Schmitt, F. O. assoc. prof. zool. Washington (St. Louis). Br 233. Berg, High.
Shears, Elizabeth sec. techn. biochem. Rockefeller Inst. (Princeton). Br 206. Ludlam (Falmouth).
Tittler, I. A. instr. biol. Brooklyn. OM 39. Swain, Millfield.
Trombetta, Vivian asst. bot. Barnard. Broderick, North.

ITEMS OF INTEREST

Dr. Rudolf Bennitt, member of the staff of the course in invertebrate zoology at the Marine Biological Laboratory for a number of years prior to 1930, has been promoted from associate professor of zoology to a full professorship at the University of Missouri at Columbia.

Dr. Ronald Grant, visiting Commonwealth fellow in zoology from the University of Edinburgh, has been appointed sessional lecturer in physiology at McGill University.

Dr. Hugh Davson, Rockefeller Foundation fellow in physiology at the University of Pennsylvania, has been appointed demonstrator in biophysics at University College of London.

Dr. Clarence D. Turner, research assistant in zoology at the University of Missouri during the past year, will become instructor in zoology at Northwestern University.

Professor S. O. Mast of the department of zoology at Johns Hopkins University left in June for the Naples Marine Biological Station. He plans to visit other European biological stations during the summer.

Dr. Helen E. Butts of the department of zoology, Wellesley College, was married in Providence, R. I., on June 26 to Mr. Donavan S. Correll, research fellow in botany at Duke University.

Dr. Viktor Hamburger, assistant professor of zoology at Washington University, left Woods Hole on July 22 for a short visit to Freiburg, Germany. He will return to the laboratory on August 26.

The fourteenth annual meeting of the Long Island Biological Association has been called for Tuesday, July 27, 1937, at 5:30 P. M., at Blackford Hall, Cold Spring Harbor. The principal business will be adjournment to a date in the fall.

A most unusual specimen currently on exhibition in the Aquarium of the U. S. Bureau of Fisheries is a live *red* lobster. Of considerable advantage to the uninitiated is the presence of a normal control in the same tank.

Choral Club

The Choral Club is making rapid progress in its biweekly rehearsals. Although one of the rehearsals was interrupted by the failure of electric power on the 8th, we are getting our program into shape for the concert to be given in August. The music we are using consists of songs selected from all countries, and ranges from devout church music to humorous folk songs. There is still time to join for any who are interested and are able to attend the rehearsals. They are held at the Coast Guard Mess (opposite the M. B. L. Mess) on Tuesdays at 9 and Thursdays at 8. —*B. G.*

Women's Symphony Orchestra to Play

The Commonwealth Women's Orchestra, the only one of its kind in the East, will make its debut on southern Cape Cod Wednesday, August 4th, at the Lawrence High School Auditorium in Falmouth at 8:00 P. M. The group of 50 musicians with S. G. Braslavsky as conductor is to appear for the benefit of The Collecting Net Scholarship Association. Tickets will be available at fifty cents, $1.00 and $2.00.

The orchestra is one of the divisions of the WPA Federal Music Project under the direction of Dr. Nikolai Sokoloff.

Dr. Gregory Pincus, assistant professor of general physiology at Harvard University, will be working at the University of Cambridge during the coming year.

Dr. P. W. Whiting, associate professor of genetics at the University of Pennsylvania, attended the Bee-Breeding Conference sponsored by the U. S. Department of Agriculture in Washington, D. C., on July 14 and 15. The discussion centered about the application of genetical and cytological findings on *Apic mellifica* to practical breeding. A solution to the problem of the pollination of red clover was foreseen in the demonstration by Dr. L. R. Watson, Guggenheim fellow at Alfred University of a method of artificial insemination. Intensive insect spraying has killed many bumblebees, the chief pollinators of the important forage crop and the development of greater tongue length in honeybees is thus of economic importance. Among the exhibits were mutant eye colors, white, yellow-green and red, and a hair character mutant, downy, which may improve pollination. The chairman of the conference was Mr. W. J. Nolan of the Division of Bee Culture of the U. S. Department of Agriculture.

CURRENTS IN THE HOLE

At the following hours (Daylight Saving Time) the current in the Hole turns to run from Buzzards Bay to Vineyard Sound:

Date	A. M.	P. M.
July 25	6:14	6:29
July 26	6:51	7:11
July 27	7:37	7:54
July 28	8:15	8:48
July 29	9:07	9:37
July 30	9:59	10:34
July 31	10:55	11:35

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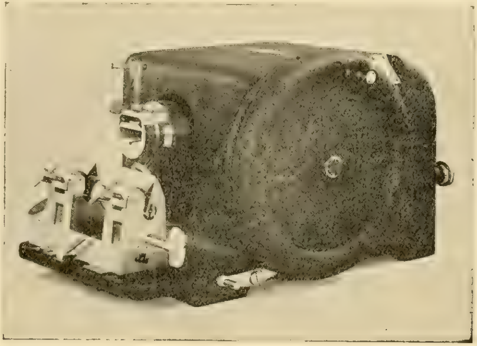

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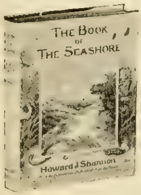

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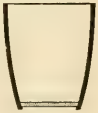
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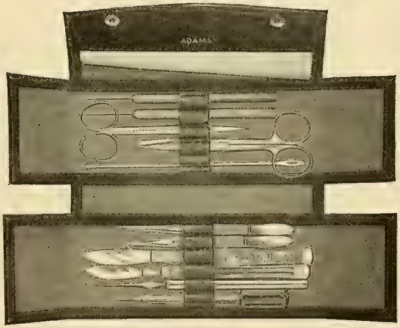

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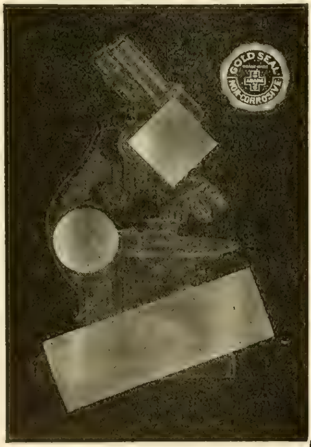

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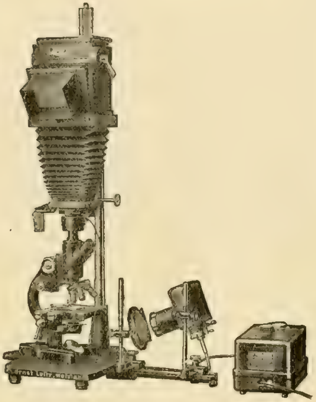

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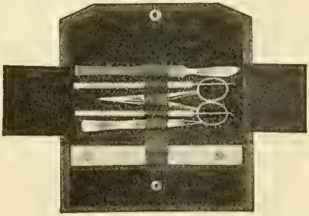

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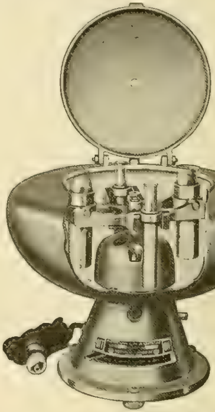

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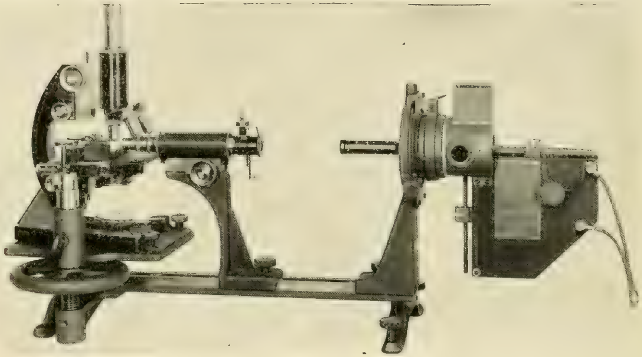
STAFF AND STUDENTS OF THE EMBRYOLOGY CLASS AT THE MARINE BIOLOGICAL LABORATORY

Standing, left to right: Dr. C. Packard, Dr. V. Hamburger, Dr. H. B. Goodrich. **First row:** E. Kotcher, J. Neel, J. Milford, R. Blanc, W. Moore, J. C. Streett. **Second row:** Barbara Leonard, Mrs. Jean Kraft, Martha Bozeman, Elizabeth Lloyd White, Gwendolynn Morgan, Marian Smith, Mrs. Elsie S. Wright, Dr. O. E. Schotté, D. E. Copeland. **Third row:** Mrs. Elizabeth T. Smith, Margaret Kellogg, F. Elizabeth Nichols, Charlotte Gross, Cleora Hatch, M. Ardell Cleverdon, Priscilla Dienes, C. F. Williams. **Fourth row:** S. Friedman, R. Griffiths, M. Mackenzie, P. Fogel, A. Moorman, Nancy Angell. **Fifth row:** I. Cornman, J. Molter, C. R. Williams, A. Logan, S. Christhilf.



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THE COLLECTING NET

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U. S. FISHERIES BIOLOGICAL LABORATORY AT BEAUFORT

Dr. Herbert F. Prytherch, *Director*

During the present season the principal investigations conducted by the Bureau will deal with the development and possible control of a sporozoan parasite of the oyster, with experimental methods for the rehabilitation of scallop- and clam-producing areas and the construction of tidal ponds in marsh areas for the propagation of the mullet and possibly other marine fishes. The mullet pond project is being carried out with the cooperation of the W.P.A. and will determine the possibilities of utilizing the extensive salt marsh areas in the South Atlantic region for rearing this species as has been done successfully in France, Japan and the Hawaiian Islands. Certain portions of these ponds will be constructed as shallow basins or "claires" and will be utilized for growing oysters and to aid in the production of natural food for the mullet.

The marine studies being conducted here this year by visiting investigators are as follows:—Dr. W. C. George, professor of histology, University of North Carolina, the blood of echinoderms and an- (*Continued on page* 106)

M. B. L. Calendar

TUESDAY, August 3, 8:00 P. M.

Seminar: Dr. P. W. Whiting: "A Convenient Test of Physical Agents as Producers of Dominant Lethals."

Dr. Bernard R. Nebel: "Cytological Observations on Colchicine."

Dr. R. Weissenberg: "Demonstration of Vital Staining Preserved in Paraffin Sections of Lamprey Embryos."

Dr. William R. Duryee: "Some Experiments on Isolated Amphibian Germinal Vesicles."

Dr. Robert Chambers: "Cortical Cytolysis of the Echinoderm Egg."

FRIDAY, August 6, 8:00 P. M.

Lecture: Professor Ernst Fischer: "Some Physical Aspects of Muscular Contraction."

OXIDATION AND CATALYSIS OF ORGANIC COMPOUNDS

Dr. L. Michaelis

Member of the Rockefeller Institute for Medical Research

Oxidation is the source of energy for the maintenance of life. The ultimate oxidizing agent in metabolism, of course, is oxygen. Yet in general the foodstuffs to be oxidized are not oxidized and, at ordinary temperatures, not oxidizable by oxygen at all. This statement holds not only in test tube experiments, but also in the living organism: e. g., sugar is not oxidized by oxygen at all, but by other oxidants, enzymes, which, after being reduced by sugar, will be reoxidized by oxygen, either directly, or again by the intermediation of other enzymes. In the absence of such enzymes, sugar can be kept almost indefinitely in contact with oxygen, except in an alkaline solution, more strongly alkaline than ever encountered under physiological conditions.

The nature of oxidizing enzymes is this: they must be capable of a reversible oxidation and reduction. In the oxidized state, they must be able to oxidize the substrate; hereby the enzyme itself is reduced.

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WOODS HOLE PHOTOBIOLOGY

Left to right: **Top row**, Invertebrate class (1936) off to dig in the sand; Beach football at the recent embryology picnic (Goodrich); **Second row**, Two "built for two" on Marthas Vineyard (Copeland self-photo); Embryologists at play on Sunday morning; Dr. Goodrich and embryology students finding out why lobsters go on picnics (Leonard); Dr. Schotté finds something interesting under the microscope (Leonard); **Third row**, Blanc, Bozeman, White and Wrightington at "Mess" (Leonard); Music on Main street; Farewell beach party for M. Lucille Nason; "The Collecting Net" does **not** go to a party, but the watermelon does and is eaten by the Columbia folk; **Fourth row**, Carvings in the recent High School Biology Project Exhibit; Drs. Richard Weissenberg and Jean Picard at the Harvard Tercentenary; Dr. Edwin G. Conklin; Drs. Tullio Terni, Robert Chambers and G. Failla; **Fifth row**, Printing "The Collecting Net" at The Darwin Press; Sir Joseph Barcroft; Dr. Laurence Irving with Dr. J. K. W. Ferguson in background; Boat in Fisheries enclosure (Weber).

(THE COLLECTING NET welcomes contributions for this page. Staff pictures made with Zeiss Ikon camera shown except where credit is given in parentheses).

This reduced enzyme must be capable of reoxidation by oxygen, either directly or indirectly through intermediation of accessory enzymes, quantitately, without loss either of energy or of substance. Biochemistry is intensely occupied with the study of reversible oxidation-reduction systems because they are models for the physiological oxidation-enzymes.

An essential method for the study of reversible oxidation-systems is the measurement of electric potentials established when their solution is in contact with a noble metal electrode. The potential can be expressed thus:

$$E = E_0 + \frac{RT}{nF} \ln \frac{\text{oxidized form}}{\text{reduced form}}$$

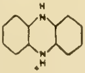
where $n = 1$ in a univalent oxidation and $= 2$ in a bivalent oxidation. E_0 is a constant characteristic of the particular system and is designated as the normal potential. In general, it depends also upon pH. When the reduced form is gradually oxidized and the potential measured during this titration, the potential varies in a manner determined by the second term of this equation. The slope of a bivalent system is accurately the half of that of a univalent system and so it is very easy to decide whether any oxidation is bivalent or univalent. In organic molecules oxidation was usually supposed to be, as a rule, bivalent in order to comply with the quadrivalence of carbon.

The normal potential may be determined for various pH's, and plotted against pH. The slopes of these curves are very characteristic and establish information about the acidic and basic dissociation constants of the substances concerned.

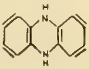
According to these rules only two types of titration curves should be found, one for univalent systems and the other type much flatter for bivalent systems. Contrary to the belief of some years ago, many exceptions to these rules have been found, especially in biologically occurring dye stuffs. The explanation is this: the bivalent oxidation in many cases proceeds in two successive univalent steps. If these steps are widely separated, one sees two successive steps in the titration-curve, separated by a jump more or less pronounced. However very often the steps are not entirely separated but overlap. In this case, a great variety of titration-curves can be obtained. From the shape of all of these curves the nature of the intermediate form of oxidation-reduction can be assertained by a mathematical analysis of their slopes. These intermediate forms always have a strong color different from that of the oxidized and reduced form. There are essentially two possibilities. The intermediate form may be a radical with tervalent carbon, or bivalent nitrogen, or univalent oxygen; these radicals we shall refer to as the semiquinone radicals. On the other hand, one might think and one did think until recently, the intermediate form to be a bimolecular associate of two such radicals, which then would be an ordinary, valence-saturated compound, but of double molecular size. The mathematical analysis of the curves has shown, that in general, the radical is established. Only quite recently, a case has been found in which the radical, when present in high concentration, is in equilibrium with its dimeric compound (in a paper with Dr. Fetcher not yet published), a fact that may hold, to a greater or lesser extent, for all semiquinone radicals. This needs further experimentation and is not very essential for the present discussion. The essential thing is that these radicals are really capable of existence. This possibility must now be explained since, in general, we look upon a radical as something very unstable.

Let us take phenazin (I) as an example. It is the parent substance of important substances occurring in living organisms. Its reduction leads to dihydrophenazin (III). The intermediate form, then, should be II, which has one bivalent nitrogen atom. We have to account for the possibility of the existence of such a valence-unsatured molecule or radical. We have to consider that this radical appears, as an intermediate form of reduction, of green color, only in acid solution. In this case a hydrogen ion will be attached. This ionized form of the radical is shown in IV. The proton is attached in the same manner as it is attached to NH_3 in an acid solution so as to form the NH_4^+ ion. However, there is no reason why the positive charge should be permanently at the upper NH group. The chance is alike that it is at the lower. Since otherwise the molecule is perfectly symmetric, there is no preference for the one or the other position and there will be a permanent shift of this charge from the one to the other position. This is accomplished by a periodic migration of one electron from the one N to the other. In the formula as drawn in IV, the lower NH group has one more electron than the upper. This electron migrates, across the bridge of C-atoms, to the upper NH group and periodically changes its place from the one to the other N. This is a periodic oscillation which is established by the electron, in addition to the orbital movement around the nucleus of that atom in the vicinity of which it happens to be at the given moment. The period of the orbit around a

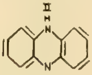
IV



III



II



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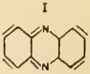

nucleus is much shorter than the period of exchange of position. Now, quantum mechanics has shown that such an exchange, occurring periodically, largely contributes to the stability of a molecule. Such a state of affairs has been termed "resonance" in quantum mechanics. This and many other types of resonance play a very considerable rôle in modern quantum mechanics. The result of the very complicated calculations is that any resonance is an important factor in stabilizing the molecule. You may think of the very crude analogy that a top is stabilized in an otherwise impossible situation by spinning. Whenever a radical is built so symmetrically that a strong resonance is established, its stability is much increased.

Besides the potentiometric experiments, there is another proof for the radical nature of the intermediate compound. The radical contains one unpaired, odd electron and should be for this reason paramagnetic; whereas an ordinary molecule with an even number of electrons should be diamagnetic. Though there is only a beginning in this kind of research, the expected paramagnetism of the semiquinone radical has been confirmed experimentally.

Whenever an intermediate radical is formed during the oxidative or reductive titration, the curve will never agree with any of the two types of curves mentioned above for $n = 1$ or $n = 2$. According to circumstances, curves will occur of the various types, flat ones, steep ones, curves with one or with three points of inflection. Whether the one or the other representative of this family of curves arises depends on the degree of the separation of the two steps which shall now be explained.

During the titration, we always have a mixture of the three forms of the dye: the reduced form, R; the semioxidized form, S; and the totally oxidized form, T. We have not only one oxidation-reduction system but three, namely the R/T system, the R/S system, and the S/T system, which will be in equilibrium with each other. At that point of titration where the concentration of R equals that of S, we may speak of the normal potential of the lower step of oxidation, E_1; when $[S] = [T]$, we speak of the normal potential of the higher step of oxidation, E_2; when $[R] = [T]$, we speak of the mean normal potential, E_m. When the two steps are widely separated, E_1 lies far below E_2 and in the middle of the curve there is a steep jump of the potential. When the two steps are less separated, the steepening in the middle becomes less conspicuous and may vanish altogether. E_1 is still lower than E_2, but less than in the former case. Furthermore, we may arrive at a situation where the normal potential of the lower step, E_1, is higher than the normal potential of the higher step E_2. The order of E_1 and E_2 is reversed. In such a case, only very little of the radical can be formed at all, but still there may be a definite though small amount. In such a case, we would say that on oxidizing the reduced form, it is easier to obtain the second step of oxidation than to obtain the first. It is the same situation in the oxidation of metallic copper, in which case one can more easily reach the cupric state than the cuprous, though cupric is farther apart from copper than is cuprous with respect to the level of oxidation. Level of oxidation and free-energy relationships need not go hand in hand.

This state of affairs may also be illustrated in this way. Suppose we prepare the semiquinone radical in pure crystalline state, which is quite easy in many cases. Now we dissolve the crystals. Immediately an equilibrium will be established between the three forms:

$$2\,R \rightleftharpoons T + S$$

The constant of this equilibrium,

$$k = \frac{[T] \times [R]}{[S]^2}$$

will be designated as the semiquinone-formation constant. If k is small, the radical will largely undergo what is called a dismutation and disappear to a great extent. If k be infinitely large, the dismutation will be complete.

A mathematical analysis of the curves shown above permits us to correlate this k with the shape of these curves. The steeper the curve, the larger will be k.

Now, a variety of titration curves, obtained experimentally with various reversible oxidation-reduction systems, all being dye stuffs, is demonstrated by graphs. The values for E_1, E_m, and E_2 are plotted again pH. There is always a crossing

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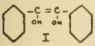
THE COLLECTING NET has been entered as second-class matter July 11, 1935, at the Post Office at Woods Hole, Massachusetts, under the Act of March 3, 1879. It is devoted to the scientific work at marine biological laboratories. It is published weekly for ten weeks between June 1 and September 15 from Woods Hole and printed at The Darwin Press, New Bedford. Its editorial offices are situated on the third floor of the Woods Hole station of the United States Bureau of Fisheries. Between June 1 and October 1 communications should be addressed to Woods Hole, Massachusetts; at other times they should be directed to THE COLLECTING NET, Garrison, N. Y. Single copies cost 30c; a subscription (containing not less than 280 pages) costs $2.00.

point of the three normal potentials and at this point $E_1 = E_m = E_2$.

So much about the results obtained from titration curves. All results are in the realm of thermodynamics and deal with equilibria. Now we come to a kinetical problem. This is best illustrated by an example elaborated recently in collaboration with Dr. Fetcher. You will very soon understand why this particular example is suitable as a model and is able to illuminate a general situation better than many other examples. We start from dihydro-stilben (I).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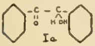
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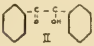
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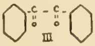
III

This substance exists only in a strongly alkaline solution in alcohol, and then it is ionized in part. Usually, it exists in the tautomeric keto form, benzoine (I_a). When crystals of the ketonic form are dissolved in alkaline alcohol, it is partially converted, rather slowly, into the enolic form. This enolic form can easily be oxidized, the end state being a diketone, benzil (III) by using as oxidant either oxygen or iodine. However, there is formed an intermediate product of an intense purple color, known for many years and proved by us to be a radical with one tervalent carbon, (II). Of course, in the alkaline solution, we have its anion instead, a hydrogen ion being split off. The negative charge of this ion oscillates between the two O-atoms, this resonance establishing the stability of the radical. According to the degree of alkalinity, more or less of this radical will be produced, since the formation constant of necessity depends on pH, just as in all other cases mentioned before. When benzil is dissolved in alcohol, but no alkali is added, no oxidation at all takes place in presence of oxygen or iodine. After adding alkali, a deep purple color arises, which suddenly fades out on shaking with oxygen. At rest, the color gradually reappears. On shaking again with oxygen, the color disappears instantaneously and reappears slowly at rest. This cycle can be often repeated and when the color ceases to appear on standing at rest, no benzoine is left and the oxidation to benzil is complete. So one sees that the oxidation which is bivalent altogether proceeds in two successive univalent steps. If, by lack of alkali, the intermediate radical can not be formed, the oxidation does not take place at all. The reason why the two steps can be so easily distinguished in this particular case is the slowness of the rearrangement of the ketonic form to the enolic, and the fact that the enolic form is much easier to oxidize than the other and, furthermore, that the intermediate radical form due to its resonance is accumulated to an easily recognizable extent. This fortunate property of this system enables us to recognize the following state of affairs. This bivalent oxidation does not proceed in a single bivalent step, but in two successive univalent steps. The oxidation has to go in single univalent steps, otherwise it does not go at all, or at least, at a rate incomparably slower. We may derive herefrom a general principle compatible with all known facts with regard to the oxidation of organic compounds.

Certainly, some oxidations may take place in such a way that oxygen combines with an organic molecule to give a peroxide and then by intramolecular rearrangement the oxygen is reduced and the organic part of the molecule is oxidized. The formation of such a peroxide cannot be, however, considered as a reaction ordinarily used by the living cell. It is rather a rare occurrence. Oxygen is not used directly as the oxidizing agent for foodstuffs, but only indirectly. If it be true that oxidation of the ordinary type can go on only in single univalent steps, we have an explanation why so many organic substances, of a highly oxidizable nature, speaking thermodynamically, are quite stable compounds in presence of air. The task of the oxidative catalysts is to facilitate the formation of the intermediate radicals. In all cases where the radical can be formed only to a very small extent, i.e., where the two steps of oxidation overlap considerably, the normal potential of the lower step of oxidation is much higher than that of the higher step. Considering the free energy involved in this reaction, we may say: while going through the intermediate stage of oxidation one has to climb over a high energy hill. The energy spent for this step, to be sure, is regained in the second step which is directed downward, but there is a barrier, an obstacle to the whole reaction. The amount of the radical which can be produced spontaneously is the limiting factor for the rate of the oxidation as a whole. Since in ordinary molecules there is no or little resonance in the radical, its concentration can never accumulate to any appreciable extent and the oxidation occurs at an infinitely slow rate. It is the task of the catalysts to shift the equilibrium concentration of the radical. Let us consider the oxidation of a sugar. We know that it proceeds in metabolism step by step, until all is burnt up to $CO_2 + H_2O$. The first of these steps is now well known. Glucose combines with phosphoric acid to form hexose—6—monophosphate. This compound, by itself, is quite as stable in contact with oxygen as glucose itself. But, in the presence of Warburg's yellow respiratory enzyme, the aldehyde group is oxidized by oxygen so as to form a carboxyl group. This is a bivalent oxidation. We do not know yet the mechanism of this reaction; we do not know even why the sugar has to be first phosphorylated as a preparatory step. But it is very likely that the sugar phosphate, when combined with yellow enzyme, is converted to something in which the passage through the intermediate radical step, the climb over the hill, is facilitated.

It can be expected, from kinetic considerations, that univalent oxidations can more easily be brought about by univalent oxidizing agents than by bivalent ones. This is a principle stated before by Shaffer, though in a little different way. Now, the yellow respiration enzyme, in its chemical structure, appears to be a bivalent oxidation-reduction system. We have yet to show that under physiological conditions it can act as a univalent system. This leads to a more detailed discussion of the yellow respiration enzyme.

This consists of a yellow dyestuff, lactoflavin, which is identical with vitamin B_2. Its constitution has been cleared up by Kurt G. Stern and then especially by R. Kuhn and by Karrer. It may be considered as a derivative of phenazine mentioned above, though one of the benzene rings of phenazine is replaced by an alloxan ring. At one of the N atoms is attached a pentose, namely vibose. The last carbon of this pentose is esterified, forming an ester with phosphoric acid. This ester of the dye is combined with a specific, colorless protein, which has been recently prepared in a pure state. Our problem was to show whether the dye stuff contained in this enzyme can be used as a univalent oxidant, in other words, whether this dye belongs to those in which the two steps of reversible oxidation-reduction can be distinctly separated and an appreciable amount of the intermediate radical be formed.

Now, soon after having recognized the structure of lactoflavin and its structural relationship to phenazin, Kuhn showed that it behaves like other phenazin compounds, such as pyocyanin insofar as it forms an intermediate radical very easily when dissolved in very acid solution. On reducing the yellow dye in such an acid solution, an intermediate intense red color is formed and in a second stage of reduction the color fades out. This process is reversible. However, this occurs only in quite unphysiologically strong acid solutions. Later on, in our laboratory, we succeeded in showing that also in neutral solution an intermediate form of reduction is formed, which has a green color. The maximum amount of this green form which can be in equilibrium with the total dye is only 10% of the total dye. Quite recently Haas, in Warburg's laboratory, went a further step ahead. When the yellow respiration enzyme, i.e. the compound of the phosphoric ester of this dye with the specific protein, is reduced by the reduced form of what is called "coënzyme," the reduction goes even at a physiological pH very distinctly over an intermediate form of red color, showing the same absorption spectrum as that formed in strongly acid solution without enzyme. Here, the enzyme performs the same function as a very high acidity would do under ordinary conditions. (You will remember that also, e.g., in the hydrolysis of sucrose, the enzyme invertase has the same effect as a strong acid would have without enzyme).

Let us now consider that enzyme itself. Warburg has discovered that it consists of a pyridine derivative, containing a sugar side chain, which is esterified by phosphoric acid and combined again with a specific protein. The pyridine part of it is the reversibly oxidizable and reducible moiety of it. This pyridine derivative is a quartenary compound derived from nicotinic acid and all those quartenary compounds of nictotinic acid behave similarly with respect to reduction. Warburg made the very surprising discovery that they can be reversibly reduced by a bivalent reduction. Later, Euler and also Karrer, showed that these substances, when dissolved in strongly alkaline solution, go, during the reduction, through a deep orange intermediate univalent step. Thus, this enzyme also belongs to those bivalent oxidation-reduction systems which can easily be caused to form a univalent intermediate step. So far I have gone and I shall not go any farther; the problem has not been cleared up in detail, but it has now advanced to the stage of a veiled monument. We cannot yet look through the veil, but we have a very definite problem before us, instead of a vague one.

(This article is based upon an evening lecture entitled "The Problem of Oxidation of Organic Compounds and Its Catalysis Under Physiological Conditions" presented at the Marine Biological Laboratory on July 23).

U. S. FISHERIES BIOLOGICAL LABORATORY AT BEAUFORT

(Continued from page 101)

nelids; John C. Ayers, graduate assistant, Duke University, respiration of decapod crustacae; J. Albert Fincher, graduate assistant, University of North Carolina, embryology of sponges; Dr. H. H. Harkins, Fordham University, prevention of fouling of ships' bottoms; Gordon H. Tucker, teaching fellow, University of North Carolina, regeneration in lower invertebrates; Fred Ferguson, Miller School of Biology, University of Virginia, marine rhabdocoeles of the Beaufort region; Dr. Henry Vander Schalie, assistant curator of molluscs, University of Michigan Museum, the Mollusca of the Beaufort area; George Wharton, Jr., graduate assistant, Duke University, parasites of marine turtles; Henry Leigh, assistant in zoology, University of Illinois, the parasites of the marine fishes; M. Amelia Stirewalt, Miller School of Biology, University of Virginia, marine rhabdocoeles of the Beaufort region; Dr. A. S. Pearse, professor of zoology, Duke University, ecology and parasites of estuarine animals.

One of the major activities of the station has been terrapin culture. Artificial propagation of the diamond-back terrapin, conducted in cooperation with the Division of Fish Culture and under the immediate supervision of Capt. Charles Hatsel, yielded during the summer of 1936 a total hatch of 10,750 young terrapin. These were cared for and fed in the special rearing house for a period of approximately 2 months during early fall after which they were placed in the hibernating pens where they will remain until the following spring. Experiments are in progress to determine whether the young terrapin can be carried over the winter in the unheated rearing house by covering them with damp seaweed and maintaining a low even temperature by protection from direct sunlight. If this is possible it will eliminate considerable labor in transferring the young terrapin to and from the hibernating pens and will afford complete protection from rats and mice.

During May 1936, 11,000 young terrapin of the 1935 brood which had been reared to an age of approximately 9 months, were distributed throughout the coastal waters of the South Atlantic region as follows:—Virginia, 3,000; North Carolina, 3,500; South Carolina, 3,000 and Georgia, 1,500. The actual planting of the young terrapin in brackish water areas was carried out by the Conservation Departments of the several states and if continued and increased each year should help to maintain a supply of this valuable seafood. Progress is being made in the development of a cooperative program whereby the various states receiving terrapin will provide funds for continuing and increasing the artificial propagation of this species.

During the past five years the Beaufort laboratory has produced for distribution an average of 10,520 young terrapin per year. The cost of rearing these animals has ranged from 3½ to 5 cents per terrapin per year which includes the labor and expense of feeding the brood stock, repairing breeding pounds, collection and care of young, etc. Previous to 1931 the production of young terrapin over a 5 year period averaged approximately 5,000 animals per year and since that time has increased to over 10,000 per year. The reason for this appears to be the purchase of additional breeding stock during the spring of 1930 which included 540 adult females that began laying in 1931 and produced an increased yield of approximately 5,000 to 7,000 young per year. Previous terrapin cultural experiments indicated that in general an average annual production of 12 eggs per female per year may be expected which is in agreement with the results obtained in this work during the past 5 years.

During 1936 the biological station continued in operation during the entire year and provided facilities for the study of marine fishery problems of the South Atlantic region. The various investigations conducted by the Bureau's staff dealt with the following problems: (1) the biology and control of the oyster drill, (2) the life cycle of a sporozoan parasite of the oyster, (3) auto-narcosis in the oyster and its industrial application, (4) destruction of oysters by hurricane on Eastern Shore of Virginia, (5) spawning of the blue crab in North Carolina waters and (6) reproduction and feeding of the commercial shrimp. The Beaufort laboratory serves as headquarters for oyster investigations in the South Atlantic region and has cooperated with the Conservation Departments of the coastal states, the Works Progress Administration and commercial fishing interests with respect to the rehabilitation of public oyster beds, restoration and protection of the shad fishery, regulation of the clam and blue crab fisheries and the continued operation of a cooperative fisherman's organization.

Laboratory facilities for marine research were provided for fifteen independent investigators from other institutions engaged in the following studies:—Dr. H. V. Wilson, professor in the University of North Carolina, completed research begun at the laboratory the preceeding summer dealing with the effects of certain narcotics on sponge syncytia; Dr. C. E. Tharaldsen, New York Homeopathic Medical College, studied the effect of cancer producing substances on embryonic development of the sea urchin; Dr. Irene Bolick, Alabama College, influence of environmental conditions on cellular behavior; Greer J. Kimery, U. S. Department of Agriculture, process of decomposition in shrimp; J. Albert Fincher, University of North Carolina, early development and regeneration in the lower invertebrates; D. John O'donnell, Illinois Natural History Survey, marine fauna of representative intertidal areas; Dr. Alan Boyden, Rutgers College, the blood relationship of animals; Gordon H. Tucker, University of North Carolina, regenerative powers of the cells of lower invertebrates; Dr. Hoyt S. Hopkins, New York University, effects of methylene blue on respiration and glycolysis in tissues of lamellibranchs; Dr. George E. Coghill, formerly of Wistar Institute, myogenic behavior in embryonic tissues of fishes; Dr. A. S. Pearse, Duke University, studies of the flatworm parasite of the oyster; George W. Wharton, Duke University, parasites of the intestinal tract of reptiles; Dr. R. H. Kudo, University of Illinois, sporozoan parasites of molluscs; Dr. E. Lawrence Palmer, Cornell University, general natural history of seashore animals; Dr. Katherine V. Palmer, president of the Paleontological Research Institution, living and fossil molluscs.

THE RESPIRATORY EXCHANGE DURING STANDING

Dr. F. A. Hitchcock, *Associate Professor of Physiology* and Dr. J. K. W. Ferguson, *Assistant Professor of Physiology, both of Ohio State University*

The CO_2 content of alveolar air falls by ten to fifteen per cent within a few minutes after assuming the erect posture. This observation, made originally by Higgins (1914), has been confirmed repeatedly by other workers, although it is not easily reconcilable with the view so ably supported by Haldane and others that breathing is, under normal conditions, regulated to maintain the alveolar CO_2 at a virtually constant level.

Various explanations for the observed fall have been proposed. All have the common feature of postulating some additional stimulus to breathing; initiated by the erect posture and sufficiently powerful to produce overventilation. The implication was that CO_2 was expelled from the body faster than it was formed by metabolism and hence the CO_2 level in blood and alveolar air was lowered.

Experiments were planned to follow the respiratory exchange during consecutive periods of reclining and standing. In each of twenty-four experiments the alveolar CO_2 level was found to be decreased by 7 to 15 percent after 10 minutes of standing. The respiratory quotients, however, did not rise as they should, had overventilation occurred. In 22 out of 24 experiments they fell. The CO_2 output during the period of standing rose in only 12 of the experiments in spite of the extra exertion of standing while the total ventilation rose in only 15 of the experiments. It is evident then, that overventilation in the usual sense of the word cannot be the cause of the fall in alveolar CO_2. It seems likely, (although experimental proof is not yet complete) that the fall is due to a failure of CO_2 produced in dependent parts of the body, to reach the lungs because of the circulatory embarrassment imposed by the erect posture.

(This article is based on a seminar report given at The Marine Biological Laboratory on July 27).

THE RELATIONSHIP BETWEEN TISSUE CHLORIDE AND PLASMA CHLORIDE

Dr. W. R. Amberson, *Professor of Physiology, Tennessee Medical School*
Dr. Thomas Nash, Dr. Arthur G. Mulder and Miss Dorothy Binns

In previous reports we have described the replacement of normal blood in mammals by several solutions in which either dissolved hemoglobin or gum acacia is substituted for the normal plasma proteins. We have recently extended the method to a study of tissue electrolytes, examining first the relationship of tissue chloride to blood chloride.

We find it possible to construct a red cell-gum-saline solution made up with sulphates of sodium, potassium, and calcium, instead of the chlorides. The red cells taken from a donor of the same species are washed through many changes of a sulphate-Ringer-Locke solution, without colloid. The chloride can be practically all removed by this treatment. The cells are then suspended in sulphate-Ringer-Locke containing gum.

After long perfusion of the body of the cat with this solution most of the chloride can be washed away. Blood and tissue samples are taken at the end of the perfusion, either immediately, or after several hours have been allowed for the attainment of equilibrium. We have been able to remove as much as 94% of the plasma chloride before death ensues. The sulphate ion appears to be relatively nontoxic. Animals may regain consciousness after the replacement of more than two-thirds of the plasma chloride by sulphate.

Our more important observations may be summarized as follows:

(1) In a few tissues, most clearly in the red blood corpuscles, the liver and the kidney, the tissue chloride is in equilibrium with that of the blood in the sense that it varies directly with the plasma chloride.

(2) In most tissues the relationship is more complex. The evidence suggests that the major part of the tissue chloride is in equilibrium with that of the plasma, but that a minor fraction is indiffusible and not accessible to perfusion. This non-diffusible fraction is particularly large in stomach, spleen, and submaxillary gland. It is probably intracellular.

(3) The major part of the chloride of peripheral nerve is diffusible, but brain and spinal cord hold most of their chloride even at the lowest plasma chloride values.

(4) Certain tissues have chloride contents so high that it appears impossible to refer all of the chloride to the extracellular spaces, as some recent workers have wished to do, mainly on the basis of measurements of muscle chloride, where the concentration is low. Thus tendon has a chloride content even higher than that of the red blood cell and lung and kidney are nearly as high.

(This article is based on a seminar report given at The Marine Biological Laboratory on July 27).

PERIPHERAL INHIBITION OF SMOOTH MUSCLE

Dr. Emil Bozler

Assistant Professor of Physiology, Ohio State University

The antagonism of excitatory and inhibitory nerves of smooth muscle was studied by recording the responses of blood vessels to stimulation of vasoconstrictor and vasodilator nerves. The method used consisted in perfusing frog legs or rabbit's ears and recording the rate of flow of the perfusion fluid by a sensitive optical flow meter. It was found that stimulation of the vasodilators blocks entirely the action of single volleys of vasoconstrictor impulses. However at a high rate of stimulation of the vasoconstrictors, a strong response can always be obtained in spite of the action of the vasodilators. During continuous stimulation of the vasodilators the first of a burst of volleys of vasoconstrictor impulses becomes ineffective; the later ones, however, are as effective as without the inhibitory action of the vasodilators.

This effect could be explained on the basis of the chemical mediation of impulses by assuming that the two mediators produced by vasoconstrictor and vasodilator impulses inactivate themselves. Acetyl choline in low concentrations produces the same effect as vasodilator impulses which supports the hypothesis just mentioned. On the other hand it was found that neither vasodilator stimulation nor acetyl choline have any influence on the reactions to adrenaline. This would be expected because the mediator produced by vasoconstrictor impulses is supposed to be an adrenaline-like substance.

The inhibitory action of acetyl choline and vasodilator impulses may best be described as a partial block for vasoconstrictor impulses. It seems possible that a change of polarization of the muscle, as has been found for the heart muscle during vagal stimulation (Gaskell effect), is the immediate cause of the block. This explanation does not contradict the theory of chemical mediation. According to Monnier the chemical mediator liberated by inhibitory impulses produces the change of polarization just mentioned and is, therefore, indirectly the cause of the block produced by inhibitory stimulation. This assumption seems to be a satisfactory working hypothesis which agrees with all the observed facts.

(This article is based upon a seminar report presented at The Marine Biological Laboratory on July 27).

THE MECHANISM OF THE LOSS OF HEAT FROM THE HUMAN BODY

Dr. Eugene F. DuBois, *Professor of Medicine, Cornell University Medical College* and
Dr. James D. Hardy, *Research Fellow, Russell Sage Institute of Pathology*

The partition of heat loss between radiation, convection and vaporization has been studied in the Russell Sage Institute of Pathology. Using the Hardy radiometer to determine total radiation it has been possible for the first time to make quantitative estimation of convection by difference. Convection cannot be measured directly.

Two normal men were exposed naked in the calorimeter to temperatures between 22° and 35°C. Their basal metabolism was uniform throughout this range and even at 22°C. did not rise until a tensing of the muscles gave warning that shivering was imminent. This casts doubt on Rubner's theory of chemical regulation. Regulation was accomplished at the lower temperatures by a vaso-constriction of the subcutaneous vessels which turned the skin into a "suit of clothes." At the higher temperatures increased sweating took care of heat loss when radiation and convection were abolished.

In the neutral zone between 28° and 32°C. vaporization accounts for about 20-30 percent of the total heat loss, convection 10-15 percent and radiation 60-70 percent. Convection is greatly increased by movement of the body or of the air. With an electric fan convection may rise to 33 percent of the total. With moderate exercise the figure may be 25-30 percent. When convection is high the body may lose more heat through a cool skin than it lost through a warm skin when convection was low.

The factors increasing heat production are balanced against the factors increasing heat loss. This balance may be shown by a diagram. On one side of the scales is a triangle representing heat production on which can be indicated the relative percentages borne by the oxidation of protein, fat and carbohydrate. On the other side is a triangle for heat loss with the percentages due to radiation, convection and vaporization. By making the triangles three-dimensional the actual calories of heat production can be contrasted with the calories of heat loss. Time, a factor common to both sides of the scales, can be shown by moving points simultaneously through both the three-dimensional diagrams. Thus it is possible to demonstrate seven variables which affect the balance between heat production and heat loss.

(This article is based on a seminar report given at the Marine Biological Laboratory on July 27).

THE DEVELOPMENT OF THE SALAMANDER, "AMBLYSTOMA PUNCTATUM"

Dr. L. S. Stone

Department of Anatomy, Yale University, School of Medicine

The development of the common black, yellow-spotted salamander *Amblystoma punctatum,* has been recorded in detail on one motion picture reel showing all the stages from the one-cell egg to the time the larva begins feeding. The rate of development was speeded up from a few hundred to several hundred times so that slower and more rapid periods in development could be more carefully analysed. The detailed study in development extends over a period of about four weeks. A constant temperature of about 70° Fahrenheit was maintained throughout this period.

During the segmentation stages one can see the movement of individual blastomeres during mitosis, the regional waves of cell division and the movement of the egg mass due to shifts in the center of gravity. A ventral view of the egg clearly shows the mass migration of cells throughout the formation of the blastopore. This stage in development is followed by the formation of the neural plate and carried through the closure of the neural folds when another shift in the center of gravity rolls the embryo over on its side and surface cilia begin to rotate the embryo upon the surface of the dish.

Throughout the early tail-bud stages one can clearly see the gradual appearance of prominent surface swellings indicating the positions of the optic vesicles, the pronephros, the fore limb bud and the future external gills. Due to the rate at which development is speeded upon the screen one can see occasional local quivering movements in various parts of the embryo which are normally too slow to be detected by any other methods of observation. In a late tail-bud stage the first appearance of motor activity is also shown.

Following these periods in development, dorsal, ventral and lateral views of embryos are shown which carry the growth up to the time the larva begins feeding. In this way one can analyse the detailed formation of many external features as well as the beginning of early peristaltic movements in the intestine.

The picture begins with a view of a typical habitat in which the adult animals live and lay their eggs. It ends with a view of several stages in development from the egg to the adult animal in order to give a comparison of size changes during growth. In appropriate parts of the film are shown clusters of eggs as they are normally laid, circulation in the tail fin of the early larval stages and a view of the larva taking its first meal.

(This article is based on a seminar report presented at The Marine Biological Laboratory on July 20).

AN INTERPRETATION OF THE SECONDARY LYMPHOID NODULES IN THE ALBINO RAT

Dr. James E. Kindred

Associate Professor of Histology and Embryology, University of Virginia Medical School

At the present time there are three views, all obtained from morphological evidence, which attempt to explain the functions of the secondary lymphoid nodule. (1) Flemming's view ('85) that the secondary nodule is a center for the production of lymphocytes; (2) Hellman's view ('21) that the secondary nodule is a center of reaction against noxious products brought into the nodule through the lymph stream; and (3) Röhlich's view ('33) that the secondary nodule is a germinal center for the production of lymphocytes and also a center of reaction to substances brought into the nodule via the blood stream. No quantitative nor experimental data have been presented to support any of these views.

The quantitative data given in this paper and obtained from a detailed study of serial sections of lymphoid nodules of the submaxillary, inguinal and mesenteric lymph nodes, Peyer's patches and spleens of eight 80-day old rats from the same litter, support Röhlich's views. Morphologically, the secondary nodules of the lymph nodes are prolate spheroids or spheres lying subjacent to the marginal sinus. At this end the nodule is capped by a cup-shaped layer of small lymphocytes and reticulum. Each nodule is roughly divided into two zones, a light zone next to the marginal sinus and a dark zone at the inner end. In the secondary nodules of Peyer's patches the dark zone is at the end which abuts against the tunica muscularis of the intestinal wall, and the light zone with its cap of small lymphocytes projects into the mucosa. The secondary nodules of the spleen are spherical in shape and completely enclosed in a layer of small lymphocytes and reticulum cells. At this stage of development there is no differentiation into light and dark zones, but of the two zones, the splenic nodules resemble histologically the dark zone.

Statistical analysis of the quantitative data, using means from median longitudinal sections of 10 nodules taken at random from each organ, shows the rates of mitosis per 1000 cells (with standard error of the mean) in the light zones to be: submaxillary nodes, 6.3(0.3); inguinals, 6.7(0.4); mesenterics, 6.0 (0.4); Peyer's patches, 5.2(.15); in the dark zones: submaxillaries, 31.(2.3); inguinals 32.(2.4); mesenterics 30.(2.5); Peyer's patches, 15.(0.5); and spleens, 19.4(0.6). Since the mitosis rate is significantly higher in the dark zone than in the light zone, it is concluded that this is the germinal center of the nodule. Furthermore, the rate of mitosis in the dark zone is also greater than in the lymphoid tissue outside of the nodules. On the other hand, the presence of a blood capillary plexus, approximately equal incidences of small lymphocytes (e.g. 54% (1.6) in mesenteric nodes; 60% (0.6) in Peyer's patches) and macrophages containing degenerating nuclei of small lymphocytes (e.g. 52.(6.3) per 1000 cells in mesenteric nodes; and 42.(2.3) in Peyer's patches) in the light zones of the nodules of both lymph nodes and Peyer's patches, suggests that the functional activity of the light zone is related to the local reaction of small lymphocytes to substances in the blood. The quantitative data suggest that the minimum rate of mitosis necessary to maintain this relation is the rate in the dark zones of Peyer's patches (e.g. 15.(0.5) per 1000 cells). The close relation between the nodules of the lymph nodes and the lymphatic channels, together with the higher rates of mitosis in the dark zones (e.g. submaxillary nodes, 31.(2.3); inguinals, 32.(2.4); and mesenterics, 30.(2.5) per 1000 cells) suggest that not only do the dark zones of the nodules of the lymph nodes function to maintain a local balance of small lymphocytes, but in addition contribute small lymphocytes to the lymph stream.

From the fact that medium-sized lymphocytes predominate in the dark zones [e.g. submaxillary nodes: dark zone 80% (0.8); light zone, 40% (2.5)] and are the cells most frequently found in mitosis (e.g. submaxillary nodes; 90% of cells in mitosis are medium-sized lymphocytes), it is concluded that the medium-sized lymphocytes are the lymphoblasts.

(This article is based upon a seminar report presented at the Marine Biological Laboratory on July 28, 1936).

NOTES AND NEWS FROM M. B. L. CLASSES

PHYSIOLOGY CLASS NOTES

This is the last round-up of physiology class news for 1937. A week ago we had no time for anything but the picnic so this will have to include the regular news of the past fortnight.

Dr. Chambers had just started lecturing on properties of the cell surface when the last regular account came through. He continued on the subject of kidney tubules and then Dr. Jacobs entertained us with "Some Aspects of the Permeability of Cells as Illustrated by the Behavior of Ammonium Salts."

Dr. Michaelis gave us a preview of his coming Friday lecture on reversible oxidation and reduction and included enough background to make us almost able to understand the more recent work he reported last Friday.

That week ended with more renal tubules as presented by Dr. Shannon. Formal laboratory work ended that same day and the following Monday found us embryonic investigators embarked on fields of our own choosing, continuing with problems which arose and interested us during the earlier part of the course.

Lectures this week included one by Dr. Cole on electrical impedance in biological material in which he proceeded to build up a fine theory about conductance of tissues and then to tear some of it down again, admitting that it probably wasn't so. Dr. Solandt talked on accommodation in nerve which included some interesting correlations of accommodation data and calcium ion concentration. Dr. Abby Turner told us about her work on colloid osmotic pressure in the blood of fishes and Dr. Ernst Fischer gave the last lecture with the longest and most imposing title of all—"The Birefringence of Muscle as an Indication of the Submicroscopical Changes during Contraction and Stretch."

So now the course is over and we are sadly taking leave of good friends, both professors and students, whom we have come to know and admire in the last six weeks. It has been a grand course and to Dr. Irving, its director, as representing the whole staff, we should like to express appreciation and gratitude for six of the best weeks of our lives. —*M. H.*

EMBRYOLOGY CLASS NOTES

By the time this article is printed we embryologists will be widely separated, turning our thoughts to new fields. But before we go there is plenty to be done.

Dr. Schotté ended his lectures with a talk on the "Organizer Parallelism between Regeneration and Normal Development" as shown by experiments in amphibians. Dr. Hadorn discussed his work on the "Significance of Nucleus and Cytoplasm as Analysed by Experiments in Merogones." Dr. Packard accomplished the impossible by summarizing the development of the Crustacea in one lecture. Friday the class had the pleasure of hearing Dr. Frank Lillie talk on "The After-feather: A Process of Twinning." On Saturday the class took to the water for a lesson in towing. Collections were made in different parts of the Hole and neighboring harbors and a busy morning and afternoon were spent in identifying the

(Continued on page 116)

The Collecting Net

A weekly publication devoted to the scientific work at marine biological laboratories

Edited by Ware Cattell with the assistance of C. P. Kraatz, Anna-Betty Clark, A. S. Cattell and Mary Goffin.

Entered as second-class matter July 11, 1935, at the U. S. Post Office at Woods Hole, Massachusetts, under the Act of March 3, 1879.

SPANISH RELIEF IN WOODS HOLE

The past week has seen injected into the quiet, professional atmosphere of Woods Hole an unfortunate situation. It is natural and right that members of the Laboratory should contribute money to the "Loyalists" or to the "Rebels" as their conscience dictates. Perhaps it is inevitable that "like attracts like" and that strong sympathizers on one side or on the other should result in the building up of opposing groups, but it is not conducive to the traditional "hands-off" policy which has so long been observed in the laboratory community when feelings run high outside the field of biology.

If the projected Quaker meeting has permanently forestalled the possible formation of a medical aid committee for the Insurgents it has surely made a definite contribution to the peace of the community. Certainly, no reasonable Loyalist or Rebel can object to the Quakers obtaining money to "be administered according to need irrespective of battle lines" for the relief of the suffering of women and children in Spain. Those interested in the Spanish situation agree that the relief of non-combatants is the essential point and that the methods by which this is done are not important. Another group, much larger, we judge, looks askance at all sides collecting money for Spain. They believe that feeding money and supplies to the opposing sides will further deplete the country of Spaniards.

For these several reasons this journal takes the position that money contributed for Spanish relief can be administered more effectively by the Quaker "Spanish Child's Feeding Mission" which has the unqualified endorsement of the National and International Red Cross. But it also believes that there are causes equally worthy of support in the United States. *W. C.*

To the Editor:

Your telegram has just come. I am hard pressed for time because data which I must examine for an important meeting Monday morning has been delayed in delivery and has only recently reached me. As I am chairman of the Committee which meets Monday, and as we must scale down applications for grants to less than half the total sum asked for, you can understand the urgency of the situation.

Instead of sending you my statement of the work of the Medical Bureau I am enclosing a leaflet from the New York headquarters which will give you the most recent figures. Any statement would include the facts mentioned on the first page.

Yours truly,

W. B. CANNON (Signed)

P. S. In my telegram of a few days ago I think I said that we send surgeons, nurses and supplies to the "legitimate government only." We do not send to the "government" but to the side represented by the government. Aid to the government as such is, I understand, not permitted by the Neutrality Act we support in our enterprises. Of course, medical ethics requires the rendering of succor to all who come into our care—enemy soldiers, if wounded, as well as those engaged in the loyalist cause. [Editor's Note: The material to which Dr. Cannon refers is printed on page 115].

AN OPEN LETTER

Dear Dr. Amberson:

Since Professor Conklin informed me last night that you were the active chairman of the local committee of the Medical Bureau to Aid Spanish Democracy and that his connection was only to act as an impartial chairman at Saturday's meeting at the home of Dr. Warbasse, I take this opportunity to clarify my position in an open letter to you so that there can be no possible misunderstanding. You have indicated that you would not like the Quaker collection of funds to seem to compete with Saturday's meeting, and hoped that it would not be "advertised" in such a way as to divert money from your committee.

A group of us feel strongly that it is not living up to the spirit and tradition of the laboratory for a group of biologists to band together to raise money which in the last analysis is giving military assistance to one side. This is especially true since the government of this country has meticulously avoided taking sides. As Professor Conklin remarked last week, during the World War and prior to our entry into it, 90% of the "laboratory" favored the "allied cause" and yet no collection of funds—even for medical aid—was made. The people did not organize into opposing groups. He commended this situation and said that it would have been "unpatriotic" to have done so before the formal declaration of war by the United States government.

It is most unfortunate, it seems to me, that a small group of members of the Laboratory should be actively trying to enlist the sympathies of all of us on one side of the battlefields of Spain. It was also your chairman who said that the resulting financial contribution would be almost insignificant, but that the psychological effect would be a great moral force for the Loyalists. Suppose that a group of Rebel sympathisers—and there are people here who feel strongly on both sides—form a committee to solicit money for the Rebel cause. Feelings would grow intense, friendships break and the quiet spirit of investigation would be sadly disrupted. I know, for I have talked with people on both sides and many can not view the situation objectively; they become excited. Divide up the whole country in this way and one will not have to go to Spain for a taste of Civil War.

You have said that people at the Laboratory look upon my interest in the current situation as part of an uncontrollable desire upon my part to battle constituted authority. That statement seems unjust when both the government of the country and the Laboratory of Woods Hole have officially decided not to take sides.

I sincerely believe that it is a mistake to publicly collect money for the Loyalist cause. I firmly believe that funds collected to relieve suffering Spain would be more effective if they were administered, not by an admittedly Loyalist committee, but by the Quaker group which spends its money non-politically and "according to need."

Under these circumstances and feeling rather strongly, I am sure that you can see that I couldn't square myself with my conscience unless I did what I could to forward the "Quaker faction." I must admit, then, that I think that in someways the work of your committee is unfortunate and that I should much prefer to see any money given for Spain administered by the "Committee on Spain" of the American Friends Service Committee.

I trust that the dual "campaign" will be taken good-naturedly by the laboratory community and that everyone will see the justification of my activities, whether or not they agree with them. You can rest assured that our efforts will be carried out in the spirit of friendly rivalry. *Ware Cattell*

IN GRATITUDE

The Commonwealth Women's Symphony Orchestra is to present a concert in the High School auditorium of Falmouth on August fourth for the benefit of our Scholarship Association. A concert scheduled at the M. B. L. Club for that evening has been cancelled and a special lecture at the Marine Biological Laboratory planned for the same evening has been postponed until Thursday. We are grateful to these two groups for their contribution to the success of the venture.

ITEMS OF INTEREST

The Annual Meeting of the Corporation of the Marine Biological Laboratory will be held in the auditorium of the Laboratory at Woods Hole, Mass., on Tuesday, August 10, at 11:30 A. M., for the Election of Officers and Trustees and the transaction of such business as may come before the meeting.—*Charles Packard, Clerk of the Corporation.*

DR. R. HOTCHKISS and Mrs. Hotchkiss sailed for Copenhagen on June 23. Dr. Hotchkiss is a Rockefeller Foundation fellow and will work in the histochemical laboratory of Drs. Linderstrom-Lang and Holter.

DR. ALEXANDER SANDOW, instructor in biology at Washington Square College, New York, has been promoted to the rank of assistant professor and is now in charge of the course in general physiology.

DR. R. A. BEAUCHAMP, formerly naturalist in charge of the British Freshwater Laboratory on Lake Windermere, has been spending a few days at the Trout Lake (Wisconsin) Limnological Laboratory.

DR. S. A. MATTHEWS, formerly associate in anatomy at the University of Pennsylvania Medical School, will go to Williams College in the fall as assistant professor of biology. Dr. Matthews is on the staff of the invertebrate zoology course at the Marine Biological Laboratory.

DR. C. K. WEICHERT, associate professor of zoology at the University of Cincinnati, with his bride visited Woods Hole several days during the past week.

The *Rainbow*, which beat the *Endeavor* in 1934 in the America's Cup race, arrived in Great Harbor, Woods Hole, on Saturday afternoon, July 24, and departed the following Monday morning.

LOST SNAKE IS FOUND

About three weeks ago a puff-adder or hog nosed snake, one of three, escaped from its keepers Wagner and Schenthal of Rockefeller 6 as a cage lid was left off, probably in some extracurricular psychological experiment. The animal could not be found and the technicians of the building went on a brief strike until they were assured of the harmlessness of the reptile. Several weeks after peace had settled, on Saturday evening, July 24, about eight o'clock, as Lipman in Rockefeller 7 was writing, a huge animated comma suddenly fell on the paper from a shelf above, changed rapidly into a question mark, then almost instantly into an exclamation mark to punctuate evoked statements. The lost snake was returned to its cage, apparently the only one none the worse for wear. A shipment of rattlesnakes from the west is expected this week-end with the same keepers in charge. The place of confinement will not be announced. —*C. P. K.*

CURRENTS IN THE HOLE

At the following hours (Daylight Saving Time) the current in the Hole turns to run from Buzzards Bay to Vineyard Sound:

Date	A. M.	P. M.
August 1	11:52	....
August 2	12:38	12:59
August 3	1:44	1:58
August 4	2:43	2:59
August 5	3:37	3:55
August 6	4:34	4:43
August 7	5:21	5:38

In each case the current changes approximately six hours later and runs from the Sound to the Bay.

WEDNESDAY CONCERT FOR SCHOLARSHIP FUND

The wholesome life of southern Cape Cod will be enriched on Wednesday evening, August 4, by a concert by the Commonwealth Women's Symphony Orchestra under the direction of Solomon G. Braslavsky. This professional group of 50 musicians will be presented in the High School Auditorium at Falmouth at 8:15 for the benefit of THE COLLECTING NET Scholarship Association.

Featured is a local guest soloist, Miss Anne Janney of Woods Hole and Philadelphia, whose vocal talent is well known among members of the summer colony.

Two Falmouth residents are members of the wood-wind section of the orchestra, Miss Arnolda Gifford on the oboe and Miss Frances Alberti on the bassoon.

The organization, sponsored by the Federal Music Project, is among the few women's orchestras in the country and provides a rare opportunity for talented female musicians to play compositions of symphonic order. With a large group from which to choose a personnel, the orchestra is able to present music of a truly artistic quality.

The conductor, Mr. Braslavsky, has an extensive musical background with experience leading orchestras both in America and in Europe. He was for some time director of the Vienna Symphony Orchestra. His program arranged for Wednesday includes:

Overture to Rosamunde	*Schubert*
Symphony No. 6 in G Major (Surprise)	*Haydn*
Peer Gynt, (Suite No. 1)	*Grieg*
Incidental Music to Henry VIII	*German*
Blue Danube Waltz	*Strauss*

For many years THE COLLECTING NET has endeavored to give financial aid to promising young men and women in beginning biological investigation. Thanks to the support of established biologists and friends, this movement has been successful; the calibre of recipients of these scholarships is attested by their increasingly greater achievements in science.

Formerly these matters were handled directly by the staff of THE COLLECTING NET. Recently THE COLLECTING NET Scholarship Association has been organized with a governing body of well-known biologists to direct its activities. Funds made available to the Association are to be administered by this group under the chairmanship of Professor Robert Chambers.

Tickets for the concert at prices of 25c to $2.00 will be on sale every morning at a table in the M. B. L. lobby. An effort will be made to provide transportation to the Auditorium for those desiring it.

ADDITIONS TO THE DIRECTORY

The Marine Biological Laboratory

STUDENTS IN MORPHOLOGY AND TAXONOMY OF ALGAE

Donovan, Mary K. teach. biol. and chem. Hyde Park H. S. (Boston). Hilton, Millfield.
Hicks, Jaqueline Barnard. Broderick, North.
Hilgeman, Dorothea Goucher. H 2.
Kalter, L. B. jun. biol. T. V. A. Forestry Div. K 12.
Lloyd, Frances V. grad. biol. Alabama. H 2.
Moseley, C. B. Dartmouth. Dr.
Runk, B. F. D. asst. biol. Virginia. K 15.
Stevenson, Barbara Wellesley. Densmore, School.
Travis, Mildred T. Pennsylvania. W.

INVESTIGATORS

Child, G. P. instr. biol. Amherst. Br 304. Taylor, Whitman.
Croasdale, Hannah res. asst. phys. Dartmouth. Bot 2. Sylvia, Gardiner.
Fenn, W. O. head dept. phys. Rochester. Br 330.
Kopac, M. J. res. assoc. biol. Washington Sq. Br 328. Hotel Avery.
Paaske, Ellen A. sec. Cornell Med. Br 317. Neal, Bar Neck.
Prescott, G. W. asst. prof. biol. Albion. Bot 25. D.
Ricci, Nelda I. asst. bact. Rockefeller Foundation. Br 315. Breakwater.
Stockard, C. R. prof. anat. Cornell Med. Br 317. Buzzards Bay.
Taylor, W. R. prof. bot. Michigan. Bot 24. D 216.
Waterman, A. J. asst. prof. Williams. OM 26. D 211-12.
Wightman, J. C. grad. asst. biol. Brown. (asst. invert.). Dr.
Young, A. C. instr. phys. Rochester. Br 330. Lyons, Woods Hole.

Bureau of Fisheries

SCIENTIFIC STAFF

Wilson, J. W. asst. zool. Duke. 149. F.
McCutcheon, F. H. asst. prof. zool. North Carolina State. 149. F.

NOTES FROM THE MOUNT DESERT ISLAND BIOLOGICAL LABORATORY

The Corporation of The Mount Desert Island Biological Laboratory will hold its annual meeting on Thursday, August 12.

Seminars are: August 3, Dr. Sewall Wright, University of Chicago, "Interpretation of the interaction of color factors of the guinea pig"; August 10, Dr. Ulric Dahlgren, Princeton University, "The breeding ecology of Hydrolimax."

SUPPLEMENT TO M. B. L. CALENDAR

MONDAY, August 1, 8:00 P. M.

Seminar: Mr. A. O. Dahl: "Pollen Analysis of the Air in Relation to Hay Fever."
Mr. H. N. Stoudt: "Gemmipary in Kalanchoe and Other Crassulaceae."
Dr. Ruth Patrick: "The Use of Diatoms from Geological Excavation at Clovis, New Mexico, as Indicators of Water Conditions."

THURSDAY, August 5, 8:00 P. M.

Lecture: Dr. Gudernatsch, on the present status of the thymus problem.

THE COLLECTION OF FUNDS FOR RELIEF WORK IN SPAIN

(Editor's Note: In order to give an account of the work of the Medical Bureau to Aid Spanish Democracy we print here some material from the July issue of the "Medical Relief Bulletin" published by the Bureau in accordance with Dr. Cannon's suggestion. We also include the Memorandum sent out by the Woods Hole Chapter.)

SIX MONTH'S RECORD

A record of six hospitals in Spain in six months, with a personnel of 99 American surgeons and nurses was established by the Medical Bureau, Dr. William J. Crookston, executive secretary, has announced.

The record in detail presents other interesting features. Since January 16th, when the first American medical unit sailed for Spain, the Americans now include: 23 doctors, 46 nurses, 20 ambulance drivers and 10 technicians.

It took $118,045 to do all this. The thousands of liberty loving Americans who gave to bind the wounds of the Spanish fighters for democracy and their women and children will be interested in these figures:

The Medical Bureau has shipped 24 motor vehicles, 18 of which are ambulances, at a cost of $40,000. In addition, 6¾ tons of auto and electrical parts have been sent, costing $3,663. At this moment 21 new ambulances are being constructed to serve the six hospitals.

But ambulances are not the only requirements of a hospital. Other supplies shipped include: 30 tons of operating room, surgical and ward supplies, drugs and medicines worth $21,714.70; 11 tons of laundry equipment costing $3,792.75; 6 tons of clothes, blankets, linens, soap, etc., valued at $3,647.50; and (this with the cooperation of the North American Committee to Aid Spanish Democracy) 13 tons of food supplies worth $3,895.50.

These figures, Dr. William J. Crookston announces, speak for the prompt and effective work of the 40 local chapters of the Medical Bureau. Now that organization is better, and the local chapters have learned much by doing, the coming months should show an even higher record of activity.

6 IN 6

A new hospital every month for six months is our proud achievement. It speaks well for the 40 odd chapters of the Medical Bureau scattered from coast to coast. It's a tribute to the thousands of individuals who have generously contributed, often at a sacrifice.

Our work is not done, however. We have learned a lot and we will do better. Like good craftsmen, however, we must have tools to work with. Our tools of conviction are literature, posters and collection lists.

To chapters and individuals we urge: *spread our literature widely*. On hand are: *From a Hospital in Spain*—letters from American nurses, selling at 5 cents. This booklet of letters sent to friends and family are colorful moving documents. Some 30,000 copies have already been printed and the demand continues.

Scholarly, warm and well written is the *Address by Dr. Walter B. Cannon*, of Harvard University. Dr. Cannon recounts his experiences in Spain and as a surgeon in the World War. It is a stirring booklet selling at 5 cents.

In the making is a *Pictorial* of some 50 photos and comment—the first photos of the American hospital personnel in action. These photos have just been received. The *Pictorial* will sell for 10 cents. Important also are the novel new posters—"Saving Lives in Spain"—in two colors and with envelopes attached. It should hang in clubs, schools and union halls.

For all use is an attractive collection list. Always have one in your pocket and see that hundreds of them are continuously working in your city. Judiciously used, this material will even better our record of 6 hospitals in 6 months.

Memorandum Sent Out by Woods Hole Committee

The tragic plight of the Spanish people during the disastrous military rebellion against the democratic and constitutionally elected government of the Spanish Republic has aroused deep sympathy among Americans of every class and party.

Suffering in Spain has been so widespread that the ordinary medical resources of the country have been totally inadequate to meet the need. As in previous crises of a similar character, Americans have gone to the aid of the victims of this conflict. An outstanding service has been rendered by the Medical Bureau to Aid Spanish Democracy. The Medical Bureau, organized last Fall under the chairmanship of our distinguished colleague, Dr. Walter B. Cannon of Harvard Medical School, early set up hospitals and other medical services in government territory to care for the non-combatant victims of air raids, and to furnish a special surgical service for wounded soldiers who cannot be cared for in the military hospitals. The work is carried on under permit of the Department of State of the United States Government and all shipments of medical supplies are legal. It is under the direct supervision of its American staff, and is the only medical work now in Spain which is strictly autonomous.

During the winter and spring, collection of funds to aid this humanitarian work among the Spanish people was made at many of the larger colleges and universities of this country. Many of the members of the Woods Hole community, however, have not previously had opportunity to hear of this work, or contribute to it. A local committee has been formed to cooperate with the Medical Bureau in Woods Hole and its vicinity.

In an effort better to inform the community of this great human need, the Committee has arranged a public meeting for the afternoon of Saturday, July 31, at 3:30 P. M. It will be held at the home of Dr. James P. Warbasse, Penzance Point. We have been fortunate in securing as our speakers Dr. Cannon himself, and Dr. Edward Barsky, Chief of the Surgical Service of the American Hospitals in Spain, who is now in America on leave.

Dr. Edwin G. Conklin will preside. It is the hope of the Committee that following this meeting, funds may be subscribed sufficient to send an ambulance to Spain. Checks may be made payable to the Medical Bureau to Aid Spanish Democracy, and mailed to Box 245, Woods Hole, Massachusetts.

DEPARTMENT OF PUBLICATIONS

AUTONOMIC NEURO-EFFECTOR SYSTEMS. W. B. Cannon and A. Rosenblueth. 229 pages; 42 figures, index. Macmillan, 1937. $4.00.

This monograph brings together many important observations reported from the laboratory of Professor Cannon during the past fifteen years. The evidence for chemical mediators in autonomic neuro-effector systems is summed up and discussed in the light of theories of transmission in other systems. The experimental procedures have opened up a new approach in the analysis of neuromuscular mechanisms.

The first five chapters provide sufficient introduction for a reader who is unfamiliar with the field and for students in elementary physiology courses. The first two chapters present clearly and concisely the morphology of the autonomic nervous system and of those effectors activated by it. The authors accept the doctrine that nerve fibers terminate inside the cells of smooth muscles and glands. Then follows a history of the development of evidence for chemical transmitters at nerve endings, work which culminated in the award of the Nobel prize in medicine to Loewi and Dale in 1936. This part of the book concludes with the evidence, mainly from British workers, for acetylcholine as a transmitter at neuromuscular junctions in skeletal muscle and at synapses in sympathetic ganglia.

The remainder of the monograph is concerned largely with the work of the Harvard laboratories on the activation of smooth muscle and glands. The evidence is presented for a chemical transmitter, sympathin, in the activation by sympathetic nerves of smooth muscles in blood vessels, the intestine, uterus, bladder, pilomotors, of cardiac muscle, salivary glands, and elsewhere. Sympathin diffuses from its site of production to activate surrounding units — muscle fibers or gland cells. Under some conditions it can be carried in the blood and act on distant effectors. Sympathin is similar to adrenine but differs from it in at least five respects. Cannon and Rosenblueth hypothesize the liberation at the nerve endings of a substance which combines with a receptor substance in the effector. The nature of this receptor determines whether the sympathin resulting from the combination shall be excitatory or inhibitory. Experimental procedures for the detection of sympathin are outlined clearly and completely.

Chapter ten deals with electrical changes in smooth muscle and salivary glands. In the interpretation of these action potentials there is much difference of opinion and a critical reader may feel that more of the contrary interpretations, particularly those of some of the French and English workers, should be discussed in this chapter. The same criticism applies to the chapters, "The Excitability of Autonomic Effectors" and "The Mode of Action of Chemical Mediators." In considering the all-or-none law a hypothetical schema of the steps in the sequence from nerve simulation to mechanical reaction in the smooth muscle is presented. The conclusion is that all steps beyond the nerve impulses are graded, since excitation of smooth muscle is chemical and not electrical. Not all investigators will agree with this conclusion.

The chapter on the pharmacology of the autonomic system discusses the drugs used to block transmission, to simulate normal transmission, and to alter in size the autonomic responses. The final chapter shows how, after the nerve supply has been cut, the smooth muscles and postganglionic neurones become much more sensitive to injected mediators.

The bibliography contains 347 references, but many papers from workers who do not agree with the theories presented here are omitted. The style of presentation is direct and coherent. Semi-outline form and many summaries add to the ease of reading. This monograph is a very valuable summary, not only for investigators, but for teachers and students of physiology and pharmacology.

C. Ladd Prosser

NOTES AND NEWS FROM M. B. L. CLASSES

(Continued from page 111)

plankton forms thus found. This last week Dr. Barth has been discussing "Localization in the Eggs of Coelenterates" and "Problems in Differentiation of the Ascidians." Dr. E. G. Conklin will close the course with a talk on "A Generation of Progress in Embryology." —*B. H. L.*

PROTOZOOLOGY CLASS NOTES

The final week of protozoology bids fair to being an anti-climax after an heroic second last week in which most of us completed more drawings than we had done in all the preceding twenty-eight days. As most of Woods Hole probably knows, sixty drawings were due at noon on Saturday. While the crowds cheered, Betty and Esther slipped under the line after a straight thirty hour vigil at the microscope. As the rest of us straggled in, the gentleman from Georgia was counting and recounting his creations, unable to determine whether he had drawn sixty-three of seventy-six of the lovely animals.

Our hats are completely off to Katherine Gurley, who, having completed the work, took her examination one week early and waltzed staunchly out of the lab singing "California, here I come."

We of the protozoology class would like to express our appreciation of the opportunity to study under two outstanding men, Drs. Gary N. Calkins and George Kidder. —*M. A. H. and V. D.*

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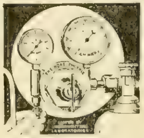

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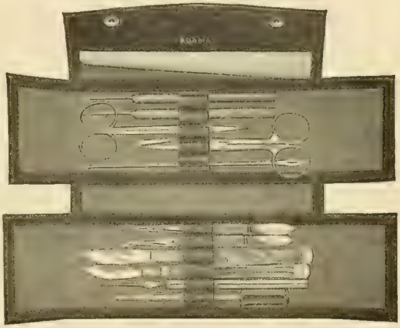

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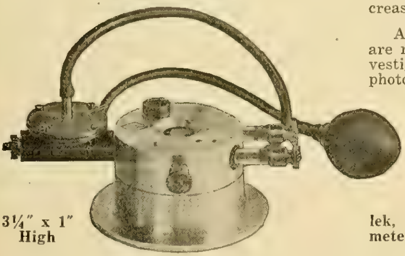

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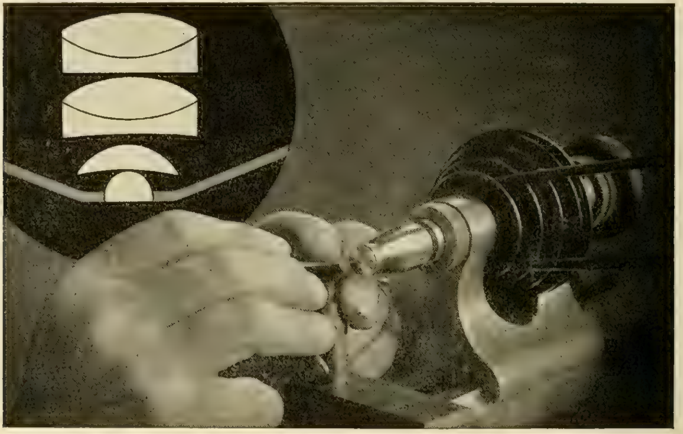

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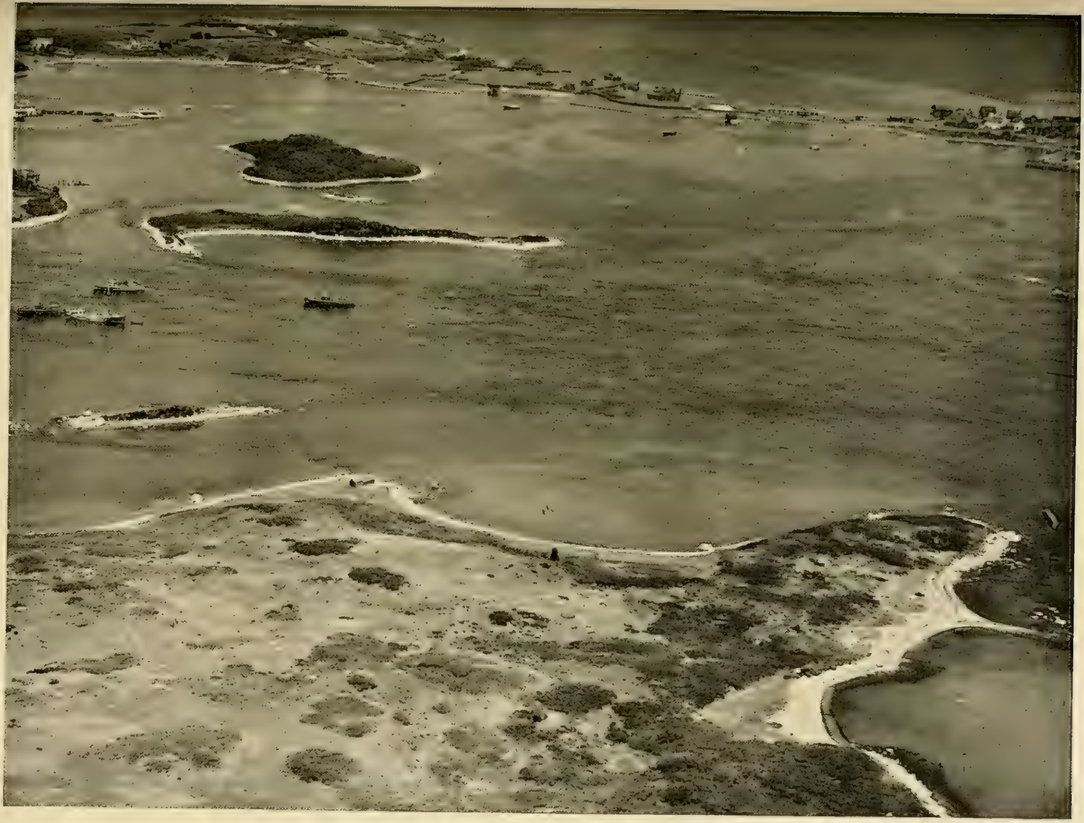

AERIAL VIEW OF PENZANCE AND THE ISLANDS FROM THE SOUTH

The south end of Nonamessett appears in the foreground with Sheep Pen Cove on the right. The islands reading from the foreground to the background are: Pine, Devil's Foot and Ram Islands. The ribbon of land in the background is Penzance Point; the tip of Dr. Warbasse's estate can be seen at the extreme left.

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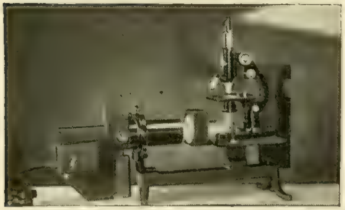

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THE CORTICAL CYTOLYSIS OF THE ECHINODERM EGG

DR. ROBERT CHAMBERS
Professor of Biology, Washington Square College, New York University

The film presents scenes showing the effect of various dilutions of sea water on the cytolysis of starfish eggs. In the greater dilutions cytolysis is spontaneous, in the lesser it is initiated by puncturing with micro needles. Cytolysis starts at one spot and spreads by spasmodic acceleration throughout the egg travelling most rapidly over the surface. The tendency for repair by the formation of prominent surface films is much more pronounced in the starfish than in the sea urchin egg.

In the least dilution of sea water in which no cytolysis occurs when the cytoplasm is torn, complete cytolysis occurs when the germinal vesicle is punctured.

The effects are also shown of tearing eggs immersed in pure salt solutions isotonic with sea water. The outflow of the cytoplasmic granules is best shown with mature sea urchin eggs in solutions of potassium or sodium chloride. During the outflow a pro-

(*Continued on page* 129)

M. B. L. Calendar

TUESDAY, August 10, 8:00 P. M.

Seminar: Dr. Francis M. Summers: "Some Aspects of Normal and Regulative Development in a Colonial Ciliate, Zoothamnium."

Dr. A. A. Schaeffer: "Morphology, Behavior and Reproduction in Type A and Type B of **Chaos chaos Linnacus**, the Giant Multinucleate Amoeba of Roesel."

Dr. Theodor von Brand: "Observations upon the Chemical Composition and the Metabolism of a Larval Parasitic Nematode."

Dr. Paul S. Galtsoff: "Observations and Experiments on Sex Change in the Adult American Oyster, **Ostrea virginica**."

FRIDAY, August 13, 8:00 P. M.

Lecture: Dr. John H. Northrup: "Concentration and Purification of Bacteriophage."

THE DEVELOPMENT OF THE AFTER-FEATHER: A PROCESS OF TWINNING

DR. FRANK R. LILLIE
Emeritus Professor of Embryology, University of Chicago

The subject of the lecture this morning must seem rather remote from the interests of the embryology class and also from previous interests of my own of which you may know. All processes of development, however, have very much in common and this topic can contribute to our conception of developmental processes in ways which I hope to point out to you.

The topic is not so remote from my previous interests as you might suppose. A good many years ago we began to use feathers in our laboratory at the University of Chicago as indicators for hormones, more particularly for the female hormone; we found that feathers are perhaps the best, certainly the most permanent, indicator for the female hormone. In the case of the Leghorn fowl that we used, the feathers of the breast of the male are black, those of the female salmon colored. If one injects the female hormone in an appropriate concentration and for the proper time a salmon band will appear across

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WOODS HOLE IN HALF-TONE

Left to right: **Top row**, Mess hall in summer; Mess hall in winter (Weber); M. B. L. Clubhouse (Leonard); **Second row**, Island boats to and from; Fish for dinner; Dr. R. Rugh about to hit one (find the ball); Dissection of torpedo ray (Godrich); **Third Row**, U. S. Coast Guard cutter (Weber); Dr. C. E. McClung; Nobska lighthouse; **Fourth row**, Dr. P. W. Whiting, Mrs. Whiting and Dr. C. B. Bridges; Trustees of Marine Biological Laboratory about to be photographed; Dr. Robert Chambers and Dr. D. E. S. Brown as the latter left Woods Hole for his European trip; Dr. C. B. Davenport; **Fifth row**, U. S. Bureau of Fisheries (Weber); Eel pond vista (Weber); Oceanographic Institution at dawn.

(Photographs not credited are "staff pictures" taken with a Zeiss Ikon Camera.)

regenerating feathers of the black breast of the male. These injections are made during the growth of the feather and if one continues them during the entire growth period the entire feather may become salmon. By varying the quantity and duration of injections, with interruptions, one can obtain banded feathers. Indeed, one can get beautiful patterns on the surface of various feathers not only by the use of the female hormone but also by means of thyroxin. One of the best instances of this is the reaction of saddle feathers of the brown Leghorn male to thyroxin. The mark obtained on these feathers indicates the degree of concentration of thyroxin and the duration of reaction. This led us to a study of the mechanism of feather development.

The part of the study that I present here this morning was undertaken after several years' interruption due to administrative obligations which took all of my time. I am glad at my age to have a subject which is not fashionable and does not put one completely out of breath keeping up with the procession.

Previous studies have dealt with the after-feather as a phylogenetic rudiment and there is also a certain amount of literature concerning its distribution in birds. Its embryonic development has been touched upon only once, in a recent paper by Anne Hosker of the University of Leeds. Like any developmental problem this leads us into the heart of fundamental biological questions.

The after-feather is found in association with unspecialized contour feathers of most birds. The classical examples are the cassowary and the emu, in which each feather is double (one is the main feather and the other is the after-feather) and they are both about the same size so that it is difficult to tell which is which. It is a curious thing that such high development of the after-feather is limited to this group of birds. In the carinate birds the after-feather is not so highly developed. It is always shorter than the main feather and is fluffy in appearance. It lies on the under surface of the feather, emerging from the superior umbilicus at the distal end of the calamus. In the fowl it is found in connection with all of the contour feathers except perhaps the hackles of the neck, but not in connection with the flight or tail feathers.

Another necessary introduction to our topic is a very general account of the development of feathers—specifically of the definitive feathers of the breast and saddle of the fowl that we have been studying. The feather develops on the inner surface of a truncated cylinder, the sheath of the feather, applied to the pulp of the feather germ occupying the center of the cylinder. The rhachis of the feather lies along one side of the cylinder designated as the dorsal side, while the opposite side is designated ventral. The feather develops between the sheath and the vascular pulp. It develops from the Malpighian layer, and the sheath is really a development of the horny layer of the epidermis. The active cells form a collar surrounding the base of the feather germ. The inner surface of the feather is next to the pulp.

The region in which the development of the barbs begins may be called the "ventral locus," because it lies approximately opposite to the rhachis. If we examine the ventral locus we shall find out how the barbs form. The cells of the collar are there dividing at a rapid rate and in the center of the ventral locus there is a triangular projection, whose sides form diverging barbs adherent at the apex and whose center remains to form by growth a new center for the formation of the next two barbs.

Now we come to a consideration of the after-feather which is studied in whole preparations made by splitting the cylinder and spreading it out flat. All stages may be readily secured. The process of development of the feather goes on quite undisturbed until about the fifth week. At that time it is about five and a half centimeters long. Then disturbances begin to appear in the ventral field. From the center of the ventral field a single barb extends up between the apices of the other barbs. It is the first barb of the after-feather. The ventral locus seems to indicate by its extent and appearance a change in the usual state of activity. Here we have a stage in which there are three barbs (exhibiting lantern slide); on each side of these three barbs there is a new triangular center, so that the previous single center in the ventral locus has actually divided into two parts and each one of these centers has the same bilateral activity as its parent. Thus we have barbs forming in two directions from each of the two centers, which results in the formation of the after-feather.

(A series of stages is exhibited by lantern slides). In the first you will observe that in the center of six after-barbs there begins to be an extension of the collar, which is the beginning of the hyporhachis. Another slide shows eight after-barbs on each side and there is evident a very clear bilateral symmetry of the after-feather. Here is a preparation of a later stage under low magnification to show the main rhachis and the after-feather, the hyporhachis and the two centers of activity.

I think you will see why we speak of the formation of the after-feather as a twinning process. It is due to an actual division of the single center from which the formation of the barbs originates. The two feathers develop with the ventral surfaces to the pulp. Thus the right side of the main feather corresponds in origin to the left side of the after-feather. When they are formed the two feathers are opposed to one another with respect to their ventral surfaces. In the more usual process of twinning each of two primordia develops into a complete structure or individual as the case may be; but in this case you will observe that one center contributes to the right side of the after-feather and to the left side of the main feather and vice versa, so that we do not have a complete feather individual formed from one center. Each center contributes to both.

If the ventral locus is a center of determination as I suggested before, it would follow that the centers should influence the respective parts to which they contribute. With reference to symmetrical characteristics the main feather and the after-feather should resemble one another very closely; with reference to asymmetrical characters the two feathers should be mirror images of one another. The first point is fully realized. As regards asymmetrical characteristics it is unfortunate from our point of view that there is usually a total lack of pattern in the after-feather and the corresponding part of the main feather. However, the barred Rock fowl is an exception to this rule. As you will see in the next lantern slide, even in the fluffy region the barring is continued. The after-feather has black bars corresponding to the black bars of the main feather and also, of course, corresponding white bars. But these resemblances are, on the whole, symmetrical resemblances. When the barred Rock is crossed with the brown Leghorn we get a disturbance of the process of barring in the lower fluffy region of the feather. In the main part of the feather the barring is usually dominant, although there are many individual exceptions to that rule. In the fluffy part the pattern is apt to be entirely absent in the hybrid and when the barring factor actually expresses itself in this part of the feather we usually find that the marks are irregular and asymmetrical; but we have the expected identity between twins—a half bar on the right side of the main feather and on the left side of the after-feather—derived from one of the centers. The contrasting white on the other side comes from the other center.

I am not quite ready to talk on the theory of this matter. Informally we might pose the question, "What is the simplest way of thinking about the developmental mechanism that we have been considering?" My first idea was to look for a morphological center that corresponds to the ventral triangle. However, that expectation met with disappointment. The simplest way, I suppose, is something of the following kind: in the ring of cells that constitutes the collar we have a gradient of activity and the ventral triangle is a kind of pace-setter for the whole performance, or, if you prefer, a high point in the gradient. I do not state this arbitrarily, but as a summary of the conclusions at which we arrived in the study of the marks produced by injection of hormones. When the concentration of the hormone is relatively low the resulting marking of the feather is next to the rhachis; as the concentration of the hormone rises the marks are found to have extended more and more toward the margin of the feather; and at the highest concentration the marks extend to the margin of the feather. We can thus demonstrate experimentally and effectively that there is a physiological gradient within the collar.

From the developmental point of view we can suppose that the same gradient of activity is what determines the pace-setting in the processes of development of the feather. As we have seen there is formed a single median ventral barb from the apex of the ventral triangle; following this we have new centers formed on the two sides. We do not know that the stage of a single median barb always occurs within this process of duplication. At any rate the problem is brought down to the place where we can tackle it in an intelligent fashion experimentally. Perhaps also we can assume that the disturbances leading to the formation of the after-feather are associated with some alteration of growth-rate of the feather as a whole.

If pace-setting is the only quality in which the ventral locus differs from the rest of the collar, how do we derive such rhythmical qualities as result in barring and other qualitative characters, which seem to have their determination in the same locus? At the present time we do not know, but we may find out from experimental analysis. Within the barbs we have a kind of repetition of the processes of barb formation. The barbs have barbules arranged along them, usually extending

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from apex to base and within the barbules a seriation of cells. Do we have to postulate subordinate pace setters?

Thus fundamental questions of biology come before us very interestingly. We have here used hybrids between races studied independently and that raises the genetic question: "How is it that dominance is so imperfect in these races?" It goes back again developmentally to these centers. It is barely possible that we may be able to get at certain correlations between genetical processes and embryological processes, something very devoutly to be desired.

(This article is a condensation of a lecture given before the Embryology Class at the Marine Biological Laboratory on July 23).

CORTICAL CYTOLYSIS OF THE ECHINODERM EGG

(Continued from page 125)

gressive shrinking of the cortex occurs indicating the existence of the property of elasticity in what appears to be an appreciably granular cortex of the egg protoplasm.

In isotonic calcium chloride and in various dilutions of sea water with calcium chloride tearing the surface of the egg occasions a coagulation of the exposed cytoplasm. However, portions of the cytoplasm may become protected from the action of the salt by the very rapid formation of liquid surface films which surround them. Tearing these films destroys them and results in coagulation of the interior. The presence of calcium chloride in the external medium is not essential for the repair of the surface of the sea urchin egg. This is shown in sea urchin eggs about to cleave in an isotonic solution of potassium chloride containing traces of potassium oxalate. Gentle compression of their eggs causes a bursting of the surface followed instantly by a repair and a subsequent normal appearance of the eggs.

With micro needles it is very difficult to lift the surface film or plasma membrane of the protoplasm away from the granular protoplasm without irreversibly rupturing the film. The last scene of the motion picture is a use of a natural phenomenon to secure the lifting of this membrane. An immature sea urchin egg is heavily over inseminated. The large insemination cones, which are localized elevations of the plasma membrane, develop so close together that a gentle manipulation with a needle causes them to run together and to exhibit a continuous film overlying a liquid space which separates the film from the granular cytoplasm. When the film is ruptured at one spot with the tip of a micro needle a wave of disintegration of the film spreads rapidly from the ruptured spot exposing the underlying cytoplasm which thereby becomes converted into an irreversible coagulum.

(This article is based on a seminar report given at the Marine Biological Laboratory on August 3).

A CONVENIENT TEST OF PHYSICAL AGENTS AS PRODUCERS OF DOMINANT LETHALS

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A modification of one of the gametes causing the death of the zygote is a dominant lethal. As Muller has pointed out, dominant lethals occurring in very great numbers in the spermatozoa cause partial or complete male sterility. Two types of male sterility may then be distinguished,—one due to lack or inactivation of spermatozoa, the other due to dominant lethals. In most animals these two types cannot be statistically separated, for the eggs fail to develop in either case.

Separation may, however, be made in a naturally parthenogenetic species. In the wasp Habrobracon with males produced by haploid parthenogenesis and females from fertilized eggs, the females are lacking if sperm are lacking or if sperm have dominant lethals. In the former case the females are replaced by males because the eggs are not fertilized and hence fecundity is not diminished. In the latter case the diminished fecundity indicates that eggs are fertilized and thereby killed.

In the type of matings summarized in the Table, about 75% of the eggs are fertilized.

Untreated females of Habrobracon (Stock 11-o) mated to untreated and X-rayed wild-type unrelated males.

R-units	Total egg-laying days	Progeny		♂♂ per day	♀♀ per day
		♂♂	♀♀		
0	379	459	1310	1.21	3.30
2,500	253	337	562	1.33	2.22
5,000	309	419	191	1.36	.62
7,500	361	627	57	1.74	.16
10,000	72	62	5	.86	.07
20,000	99	95	0	.96	0
40,000	117	157	0	1.34	0
75,000	515	890	0	1.73	0
Unmated ♀♀	675	3191	0	4.73	0

The first row giving progeny when males are untreated shows daughters about three times as numerous as sons. Fecundity is estimated by dividing total number of progeny by total number of days of life (egg-laying days) of all the mothers. Males per day relative to females per day equals proportion of unfertilized to fertilized eggs since viability is normally about the same in the two sexes. If the fathers are x-rayed, decrease in daughters is noted, but there is no consistent change in number of sons. Even with 75,000 R-units the males per day are not higher than with 7,5000 R.

Fluctuation in males per dav from different mated mothers is due to differences between individual fraternities, with exhaustion of sperm supply tending to increase number of sons and with recessive lethals tending to decrease them. From unmated mothers the sons equal (or here even exceed) total progeny when fathers are untreated. Even with 10,000 R-units a few daughters appear so that some of the sperm have no dominant lethals.

Whether the dominant lethal effect is due to some "toxic" influence of the treated sperm inactivating a normally parthenogenetic egg (before syngamy) or is due to induced chromosomal or genic irregularities interfering with normal cleavage (after syngamy) should be determined by embryological studies.

X-radiation which causes dominant lethals, also produces recessive lethals and visible mutant changes. Preliminary tests with neutrons show dominant lethals, while ultra-short radio waves (one meter) have failed to do so. If dominant lethals are due to chromosomal irregularities, as seems likely, we may then expect recessive lethals and visibles after neutron treatment but not after treatment with radio waves. Other physical agents may be similarly tested.

These experiments have been aided by grants from the Committee on Effects of Radiation on Living Organisms (National Research Council).

(This article is based on a seminar report given at the Marine Biological Laboratory on August 3).

CYTOLOGICAL OBSERVATIONS WITH COLCHICINE

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The action of the alkaloid colchicine on mitosis was studied in the following material: stamen hairs of Tradescantia, roots and shoots of Zea, Tomato, Tagetes, Antirrhinum, Trifolium, Papaver, Dianthus, Solanum, and Lilium,—testes of Podisma, eggs of Asterias and Arbacia.

In Tradescantia all stages of mitosis are easily seen in life. The cells will continue to divide in salt-sugar solutions to which drugs may be added.

Colchicine in concentrations of 5×10^{-4} to 5×10^{-5} molar will stop mitosis during metaphase. In concentrations of 5×10^{-5} to 10^{-6} molar it tends to produce binucleate cells. When blocked in metaphase the chromosome plate in Tradescantia is characteristically tilted, since a true spindle is not developed.

A comparative study of phenyl-, amyl-, propyl-, ethyl urethane and chloral-hydrate showed that these anesthetics within their respective reversible concentration ranges will only occasionally produce binucleate cells. There is no particular evidence of a metaphase block with the urethanes. In studying the action of Colchicine on the developing egg of *Arbacia punctulata* it was necessary to use fixed material to determine the nuclear division stage. Colchicine applied 10 minutes after insemination will block the first cleavage metaphase in concentrations above 10^{-4} molar. Between 6.5×10^{-5} and 3.5×10^{-5} molar nuclear divisions of abnormal type proceed while cleavage is impeded. The rhythm of nuclear division may persist so that when controls are in 3rd cleavage metaphase the eggs to which colchicine was added 10 minutes after fertilization will also show approximately 4 groups of chromatin, but the plates are hypoploid often containing only one to six separate chromosomes, which may represent fused units. The micronuclei which form are not far apart from one another and their resting stage is relatively short. With lower concentrations the rhythm of division is not affected in the early cleavages, but the subsequent development of the larvae is markedly stunted even at 10^{-6} molar. Colchicine in increasing concentrations thus first interferes with the normal course of cleavage. At the same time astral rays are reduced in size and gradually prevented from forming, next the spindle is reduced in size and finally obliterated. These three phenomena may partially overlap. Meanwhile chromosomes become pycnotic during a prolonged metaphase, they fail to divide orderly, the abnormal division separating entire chromosomes rather than split halves.

In the plants, in which root and shoot growth was studied (Ruttle) cuttings and seedlings respectively were subjected to colchicine treatments by immersion in aqueous solutions primarily. The active concentration ranges were found to be the same as in Arbacia and Tradescantia. All genera showed marked reactions, the tomatos being the least sensitive. Where plant meristems were treated, the resulting tissues showed markedly irregular growth—incised and crumpled leaves as well as chlorophyll defects. Cytological investigation showed necrotic cell lineages and multinucleate cells in varying degrees. The drug is being studied further as an agent which may induce mutations and polyploidy.

In cooperation with other investigators, some physiological effects of colchicine were investigated. Respiration was tested on Arbacia eggs with colchicine 1.8×10^{-5} to 7.5×10^{-5}. Respiration did not vary from the control in any of these concentrations (Tyler).

Pectin methoxylase (Pectase) from tomato juice showed inhibition which is of doubtful significance since with higher concentrations of colchicine a precipitation was observed in the reaction mixture (Kertezz).

The nitroprussiate reaction for $S—H \rightleftharpoons S—S$ groups gives a color reaction in stamen hair cells of Tradescantia the color being located in the chromonemata and in certain plasmatic granules. Cells under colchicine gave the same reaction (Medes).

No significant influence was observed on the action of carbonic anhydrase from blood.

No inhibition occurred of the reduction of methylene blue by yeast or blood with and without admission of air.

No sensitization of Arbacia eggs to x-rays was obtained by the addition of colchicine, when nuclear abnormalities were used as a criterion.

(This article is based on a seminar report given at the Marine Biological Laboratory on August 3).

BISMARCK-BROWN AS A VITAL DYE FOR LOCALIZED STAINING ON THE EGG OF LAMPREY AND THE OPPORTUNITY OF PRESERVING IT FOR PARAFFIN SECTIONS

Dr. Richard Weissenberg

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The method applied by me since 1929 for studying the result of localized vital staining on the egg of lamprey in paraffin sections is a very simple one. I use Bismarck-brown instead of Nile-blue sulfate or neutral red for localized staining of the eggs in the early gastrula stage. After having studied the transformation and change of location of the stained areas on the living eggs for some days I then fix the embryos in a mixture of 1.5 parts of absolute alcohol and 0.5 part of acetic acid for ten minutes, wash in absolute alcohol for ten minutes and transfer them directly into cedar oil.

The stained areas are completely preserved by this simple method and the eggs can remain in the cedar oil for years without any loss of the dye. They can be studied in the cleared condition in the cedar oil as total preparations or they can be imbedded in paraffin at any time and cut with complete preservation of the vital stain within the sections.

When I first described the successful application of Bismarck-brown for localized vital staining of the egg of lamprey (*Lampetra fluviatilis*) in 1929 I recommended a mixture of aqueous solutions of picric acid, formalin and cane sugar for the fixation of the eggs and their stained areas (*Arch. Entw. mech. 118*). But soon after that I found that the application of this fluid is not necessary to make the vital staining alcoholproof for the passage of the eggs through alcohol into cedar oil and paraffin. Moreover, I discovered the surprising fact that, in contrast to Nile-blue sulfate, Bismarck-brown in the vital stained areas is alcoholproof without further ado (*Sitz. ber. Ges. naturf. Freunde Berlin 1929*). Therefore, I now prefer the direct fixation with absolute alcohol and acetic acid as a quick working method.

Only the yolk granules carry the dye in the stained areas of the lamprey embryo because nere, in contrast to most amphibian eggs, pigment granules are missing in the earlier stages.

The six preparations of paraffin sections through lamprey eggs which I demonstrated last Tuesday at Woods Hole are now seven to eight years old and still give a true representation of the behaviour of the stained areas of the living embryo.

I believe that the Bismarck-brown method will also be suitable for eggs of other groups of animals if the cells of these embryos contain yolk granules and if the egg membranes do not hinder vital staining. As to amphibian eggs I have applied Bismarck-brown with success on the egg of Amblystoma for studying the stained areas on paraffin sections. Wintrebert too has reported in 1932 favorable preservation of Bismarck-brown stained areas in paraffin sections after fixation of the eggs in Zenker's fluid (*C. r. Acad. Sci. Paris 194, 1013*).

(This article is based on a seminar report and a demonstration given at the Marine Biological Laboratory on August 3).

MICROFILM ON SOME EXPERIMENTS ON ISOLATED AMPHIBIAN GERMINAL VESICLES

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The film shows colloidal changes in the frog ovocyte nucleoplasm, nucleoli and chromosomes brought about by relatively slight changes in the Na, K, Ca chloride concentrations of the medium. H^+ ions reverse the normal negative charge on the nuclear components to positive. When this change is gradual enough, as with 0.003 N. HCl, a dark converging "ring" formed from flocculating particles in the approximate pH region of 4.0 to 5.0.

Ca, Mg, Cu, Hg and basic dyes behave similarly to H^+ ions in causing a phase separation and an appearance of chromosomes from a previously transparent nucleus. On the other hand, K and Na and especially OH^- tend to disperse the nuclear colloids, thus stretching and separating the chromosome pairs and at the same time making the nucleus transparent. Within narrow limits these changes are reversible.

In *Triturus pyrrhogaster*, the "Binnenkerper," or first maturation spindle anlagen situated at the germinal vesicle, can be made to swell and separate the chromosomes radially, but not in typical bipolar directions. *Rana fusca* appears unique in having a differentiated coagulable capsule around the chromosomes, which may be important in forming the denser portions of the spindle. In *R. pipiens* the contraction of this material under the influence of calcium is less striking.

Similar changes, including phase separation and violent contraction of the chromosomes, occur when acid fixatives are added or when the nuclei are exposed to their disintegrating cytoplasm. Hence this latter effect may be termed *autofixation*. Prominent differentiated areas or sac-like projections of the nuclear membrane reversibly swell and shrink in bases and acids respectively. Such structures are obliterated by fixatives. It is concluded that in the forms studied Darlington's assertion as to the absence of a nuclear membrane must be modified. With merely fine forceps and pipette it is easily possible to isolate various components of the nucleus,—e.g. nuclear membrane, spindle anlagen, nucleoli and chromosome pairs,—during the fall, winter and early spring months of the year.

(This article is based on a seminar report given at the Marine Biological Laboratory on August 3).

FREE CALCIUM IN THE ACTION OF STIMULATING AGENTS ON ELODEA CELLS

Mr. Daniel Mazia and Dr. Jean M. Clark
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This work on the cells of Elodea was planned to test an hypothesis which forms part of a general theory of the action of stimulating agents on cells. The whole theory has been developed by Heilbrunn and his students to explain the complicated series of colloidal changes which they have observed (and measured) when cells—particularly amoebae—are exposed to various stimulants. The hypothesis to be tested is, that the application of stimulating agents causes a release of calcium within the cell.

Really to test such an hypothesis, the effects of all types of stimulants must be investigated, preferably in single, living cells and, still better, without the introductions of extraneous reagents. This can be done by using the cells of the common aquatic plant, *Elodea canadensis*. These cells contain a high concentration of soluble oxalate in their sap. Any increase in the free calcium is therefore immediately indicated by the formation of calcium oxalate crystals in the vacuole.

The crystals were identified as calcium oxalate by a study of their solubility and, more convincingly, by measurement of their refractive indices. They were found to be soluble in sulphuric, but insoluble in acetic acid, which is characteristic of calcium oxalate. Their refractive indices, measured by the immersion method with the help of the polarizing microscope, were those of the monohydrate and trihydrate of CaC_2O_4.

To make the test as general as possible, Elodea leaves were subjected to the action of a variety of general stimulants—direct electric currents, condenser discharges, mechanical shock, heat, ultraviolet radiations and hypertonic solutions.

When 0.5 - 1.0 milliamperes were applied for a second or less to a leaf under observation, small crystals immediately appeared in the vacuole at the anodal end of the cell. Slightly longer treatment caused the formation of more crystals at the anodal end. With a duration of about 5 seconds, the protoplasmic layer shrank at the anodal end and a dense layer of crystals was deposited at the boundary. At this stage the cell could no longer be plasmolyzed.

Condenser discharges from a 2 microfarad condenser charged at 20 volts also caused the release of calcium toward the anode. More shocks produced more crystals up to the point of the death of the cell, after which no further calcium release was obtained.

The effect of mechanical shock was studied simply by tapping leaves which had been placed between two glass slips. It was found that mechanical shock caused the release of free calcium (indicated by the precipitation of many small crystals). This result was predicted on the basis of viscosity measurements by Mr. Angerer.

Ultraviolet radiation had previously been observed by two other workers, Nadson and Rochline-Gleichgewicht, to cause the appearance of crystals in Elodea cells, although no interpretation was given for their observation. Repetition of their experiment verified their results: a few minutes' exposure to a quartz mercury arc did cause a definite precipitation of crystals, although none were observed in other leaves protected from the rays by glass covers.

In studying the effect of heat, sudden exposures to a temperature of 70 degrees or over were tried as well as heat treatments such as are effective in activating marine eggs. The high temperatures killed the cells without causing any Ca release, but treatments such as 40° for 60 minutes, 45° for 20 minutes or 50° for 10 minutes caused a profuse precipitation of monoclinic calcium oxalate crystals without destroying the ability of the protoplast to plasmolyze in 0.3 molar sucrose solutions.

Treatment of the cells with hypertonic solutions, which themselves might or might not contain Ca, was effective in causing a release of calcium. The crystals did not appear, however, until the cells were restored to distilled water or various isotonic or hypotonic solutions for deplasmolysis.

Crystals could not be obtained, however, as the result of prolonged immersion in isotonic NaCl, KCl and $CaCl_2$, although the first of these sometimes acts as a stimulant.

Summarizing the positive part of this report: all the general protoplasmic stimulating agents do cause a release of calcium in Elodea cells, as predicted. The hypothesis could be completely generalized by similar micro-chemical studies on other types of cells.

To complete the test, however, it was necessary to see whether washing of the cells with oxalate, which has been supposed to prevent the calcium release in cells exposed to stimulating agents, would inhibit crystal formation. The cells were washed in 0.05M sodium oxalate and subjected to electrical shocks, heat, ultraviolet radiations and hypertonic solutions. It was found that no matter how severely these agents were applied, no crystals were produced in oxalated cells. It could be shown that the only effect of the oxalate was to remove Ca—if the cells were transferred from the oxalate after a few minutes and washed in distilled water, they still did not release calcium when the stimulating agents were applied. If they were then placed in pond water or a dilute $CaCl_2$ solution, and the same agents applied, their behavior was normal, and crystals were produced. Washing with citrate had the same effect as washing with oxalate.

Therefore, both parts of our work bear out the theory of Heilbrunn which we were testing. Stimulating agents do cause a release of free calcium in the cell and washing with agents which remove calcium does prevent this release. The source of this calcium must be in the cell, because the results obtained did not depend on the presence of calcium in the outside medium. The fact that washing of the cell prevents the formation of the crystals, and that this effect is easily reversed by return to a Ca-containing solution is consistent with the idea that the calcium compounds which release calcium on the application of a stimulating agent are in the cortex or the surface of the cell.

(This article is based upon a seminar report presented at the Marine Biological Laboratory on July 14, 1936).

POLLEN ANALYSIS OF THE AIR IN RELATION TO HAY FEVER

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This study has been carried on for the last five years at the University of Minnesota in close cooperation with Dr. C. O. Rosendahl, Chairman of the Botany Department and Dr. R. V. Ellis of the Medical School.

A simple fact not always recognized is that it is the buoyant wind-carried pollen from plants with inconspicuous flowers and not the heavier insect-carried pollen from plants with showy flowers which is chiefly involved in the allergic disorder, hay fever (perhaps more aptly called "pollenosis"). It is absolutely essential for the successful diagnosis and treatment of hay fever that detailed data concerning the concentration of pollen in the air of any species at a given time or locality be made available. Records of the pollen content of the air have been obtained by exposing each day an oil-coated slide out of doors for twenty-four hours. The pollen grains observed in 25 systematically distributed low-power fields are identified and counted. The approximate number of pollen grains per cubic yard of air can be calculated (given: these counts and the dimensions of the pollen grain) by use of physical formulae. In general, pollen grains of various species are morphologically distinguishable although some species possess great similarity. The pollen grains involved in hay fever vary from approximately 15 to 80 micra in diameter.

Hay fever is a regional problem and the atmospheric data for one locality will not intricately apply to another place. However, general similarities do exist as can be seen from a comparison with data for Yonkers, N. Y., given by Dr. R. P. Wodehouse and for this reason a brief summary will be given. In Minnesota, pollen concentrations of clinical interest occur between late March and early November. During April and May, pollen of trees and shrubs predominate. Cottonwood, elm, box elder, oak, birch, and ash are responsible for heaviest concentrations. The atmosphere during June is largely taken over by grass pollen, while in July various Chenopods are most important. It is during August that the pollen responsible for most suffering is prevalent. Ragweed is involved in by far the greater number of late summer hay fever cases. However, it is to be emphasized from Dr. Ellis' findings that multiple rather than simple sensitivity is the rule. Critical concentrations of ragweed pollen occur between August 15th and September 15th.

For purposes of clinical convenience the pollens found in the air during the entire season have been placed into 16 groups. Thus, in diagnosis, one scratch-test for each group will test the patient's sensitivity to all pollens present during the entire season. Prefaced by such procedure, a desensitizing extract, which includes all those pollens which have been demonstrated to be involved in the case, is individually made up for each patient. By a series of injections, beginning with very dilute extract to more concentrated, the patient attains resistance to the irritating pollens. Time at which desensitization must be started is obviously based upon pollination data. Dr. Ellis reports very favorable results with this procedure.

(This article is based on a seminar report given at the Marine Biological Laboratory on August 2).

THE USE OF DIATOMS FROM GEOLOGICAL EXCAVATIONS AT CLOVIS, NEW MEXICO AS INDICATORS OF WATER CONDITIONS

Dr. Ruth Patrick

Professor of Botany, Pennsylvania School of Horticulture

During the summer of 1932 the Academy of Natural Sciences of Philadelphia and the University Museum of Philadelphia sent out a geological expedition to New Mexico. The first work was done in the Guadalupe Mountain region of New Mexico. During the latter part of the summer the attention of the expedition was called to some artifacts and skeletons found by a road construction company in a gravel pit near Clovis, New Mexico. Excavations were made but the stratigraphy in the pit was not clear. During the summer of 1936, the work near Clovis was resumed and an excavation known as Mammoth Pit was made. Samples of materials were collected from each stratum, care being taken that the samples were kept free from contamination.

Mammoth Pit lies between Clovis and Portales, New Mexico. This pit is located in the "Llano Estacado" or Staked Plains region. The stratigraphy of this region is very interesting. The lowest level consists of coarse gravel. Above this is a layer of speckled sand which is about one and a half feet thick. It is in this layer that we find the first evidence of a diatom flora. The flora, though not too well developed, seems to indicate a fresh to brackish water condition. It is in this level that the skeletal remains of the horse are found. The next level known as the "bluish clay" level is about three feet thick. An analysis of the "bluish clay" shows that it has about the same constituents as the speckled sand except that it is rich in carbonized vegetable matter. In the lower part of this level a very rich diatom flora consisting mainly of fresh water species was laid down. The change in the abundance and also in the kind of species from the previous level point to a freshening of the water. This agrees with the other geological evidence that this was a period of much higher precipitation than now exists in New Mexico. The mammoth skeletons are most abundant in this part of the layer where the diatoms seem to indicate the freshest water conditions. As you pass from the bottom to the top of this layer, the typical fresh water species disappear. The dominant species in the top part of the layer are the brackish or alkaline water types such as *Epithemia argus, Rhopalodia gibba* and *R. gibberula.* Coincident with the change in diatom species there is a change in skeletal remains in which the mammoth bones disappear and the bison skeletons become much more numerous. The top layer consisting of brown dune sand, which is about two and one half feet thick, showed no evidence of a diatom flora. It is in the bottom of this layer that the bison bones disappear. Thus the change in water conditions as shown by diatoms seems to coincide with a change in the fauna as shown in this stratigraphy.

(This article is based on a seminar report given at the Marine Biological Laboratory on August 2).

THE USE OF POLARIZED LIGHT IN BIOLOGICAL SCIENCE

Vance Tartar and Oscar W. Richards

Polarized light is a valuable tool for biological investigation that has been used for nearly a century. Progress has been slow because of the cost of equipment for this type of work. The development of *Polaroid* makes available a simple and relatively inexpensive means for the production and analysis of polarized light. This review presents a brief resumé of past studies in this field and investigations now in progress; and suggests problems that should yield important advances in our knowledge of plants and animals.

The Differentiation of Histological Structures

Polarized light has a very important use in distinguishing the morphology of minute organisms or of sectioned material on slides. Certain tissues, notably muscle, nerve, and all sorts of skeletal structures, are birefringent and when observed under the polarizing microscope stand out brilliantly in a dark field with a distinctness which is impossible to obtain by other methods.

A few examples will suggest the possibilities that lie in this direction: in polarized light the crystalline inclusions in protozoa appear as brilliant little points of light, and their structure and distribution can be determined; the beautiful spicules of sponges and the skeletons of many types of lower animals can be studied in this way; muscles and other tissues can be traced in sectioned material where they might otherwise be distinguished less easily; the presence and distribution of injested wood can easily be seen in the shipworm.

A variety of such histological applications of polarized light will be found in the older work of Valentin (1861), and in the recent comprehensive summaries of Schmidt (1924, 1937). The reader is referred to these works for further suggestions.

The calcified structures of the body and calcification during disease may be studied to advantage with polarized light. (Cape & Kitchin, 1930). In fact many crystalline deposits or stones may often be recognized early by this means.

The natural and artificial textile fibers, lignified tissues, keratinized or chitinized tissues show distinct color differences with polarized light which aid in the identification of their presence and condition; an application of practical importance in industry as well as in biology.

A recent application of great interest is the use of the polarizing microscope for the detection of the appearance and progression of the degeneration of the myelin sheaths of nerves after they have been sectioned. Setterfield and Sutton (1934-35) find that degenerative changes can be detected as early as three hours after cutting, whereas with other methods no change was seen until 48 hours had elapsed.

The Functional Analysis of the Intimate Structure of Organisms

A large part of modern biology has been directed to the analysis of living organisms in terms of physical and chemical units. Since protoplasm is largely colloidal in nature, this analysis leads in one direction to the individual colloidal units, the colloidal micellae. Under two conditions these fundamental units are visible in the aggregate in living organisms seen under the polarizing microscope. The first condition is that the micellae be rod-shaped; for when they are spherical, they are isotropic and have no influence on polarized light: the second circumstance is that the micellae be oriented so that their axes are all in one direction. These two factors are commonly combined so that the anisotropy of orientation (form birefringence) is added to that of the individual micellae (rod birefringence).

The type of investigations which fall under the heading of this section have as their aim the study of the intimate, submicroscopic structure of living protoplasm with an attempt to interpret the functions of certain tissues in terms of these finer units.

a) Muscle

One such tissue is muscle, which, like all contractile structures, shows optical activity. The birefringent Q-discs of striated muscle are particularly well known. The problem of the correlation of changes in birefringence of the muscle with the phenomena of contraction has recently been reviewed by Fischer (1936b) who has extended the observations to living smooth muscle (1936a). It is possible to separate the two factors of form birefringence and rod birefringence, referred to above, so that the change in each, as well as the change in total birefringence can be observed during the contraction of the muscle. Under these circumstances, a decrease in both the anisotropy of the individual micellae and of their orientation occur on contraction. This result fits in well with the findings from X-ray studies in which a folding of the repeated constituent unity of the muscle is seen to accompany contraction. It is evident that these methods greatly extend our knowledge of the intimate mechanism of muscle contraction.

b) Nerve

Nerves are another type of cells in which the study of ultrastructure by polarized light gives promise of important contributions. While the axons themselves are weakly birefringent, it is the sheaths of the nerves which show most strongly this character, and it is to them that studies have been so far confined.

Conventional histological technique reveals a laminated structure in the sheath concentric about the axon. From polarized light and X-ray studies the conclusion seems now well founded that these lamina represent alternate layers of protein and lipoid micellae. Since the protein micellae give a birefringence positive with respect to the axis of the fiber and the lipoid elements have a birefringence of the opposite sign, the two contributions can be separated; for when the nerve is immersed in a medium, such as glycerin, the positive birefringence of the protein fraction is obliterated and the negative birefringence of the lipoid is revealed. Conversely, when the nerve is treated with lipoid solvents, the lipoid contribution to the total birefringence of the nerve is removed and that due to the protein alone can be measured. When the amounts of birefringence are determined by these ingeneous methods, it is possible then to measure the relative proportion of the two chemical constituents in the sheath.

It seems likely that the relative amounts of lipoid and protein in the nerve are responsible for certain characteristics of the propagation of the nervous impulse. Thus, it is found that the relative amount of lipoid decreases with decreasing fiber size, and this is evidenced by a change in the sign of birefringence at 2μ diameters. This diameter is precisely the point of transition from medullated to non-medullated fibers in the vertebrate nervous system. Corresponding to the decrease in fiber diameter and to the greater preponderance of the protein constituent, is a decreasing velocity of the conduction of the nervous impulse. It is further found that although non-medullated invertebrate nerve fibers may be far larger in diameter (50μ), they have the same optical activity as non-medullated vertebrate nerve fibers, and a similarly slow rate of conduction. The sign and degree of birefringence is, therefore, a more certain criterion of velocity of conduction than fiber size.

It is significant that the axon sheaths of fibers from widely different animals (Bullfrog motor root, lobster ventral cord, cat corpus callosum) show the same general type of molecular orientation. When compared with purely chemical systems (pure crystals), it is seen that the constituents of the sheath show a surprisingly high degree of orientation.

c) The Red Blood Cell

A condition in many ways similar to that of the nerve sheath is also found in the membrane of the red blood cell. The method employed has been to lyse the cells to free them from hemoglobin and then to examine the empty cells by the methods described above for nerve. From these studies Schmitt, Bear and Ponder (1936) conclude that ". . . the structure of the envelope of the cells may be interpreted as consisting of layers of protein particles or lamellae, with long axes oriented tangentially, and interspersed lipoid micelles or aggregates whose optical axes are radially oriented."

d) The Egg

Recent work by Vlès (1934) on the sea-urchin egg gives hope that research with polarized light will enable us to determine something about the structure of the egg on the molecular level, a problem of the greatest significance for embryology. Vlès finds that there is a small anisotropy of the egg which varies between individuals and in different stages of division. Unfortunately, the original paper was not available so that the method by which this optical activity was revealed cannot here be described.

Photography

Observations made with polarized light may be recorded by photographs and the problems and technique have been discussed recently by Baird (1936) and by Tuttle and McFarlane (1935).

Irradiation of Organisms with Polarized Light

The third general type of work relates to the problem of whether polarized light as a type of energy has an effect different from unpolarized light upon organisms. There is, unfortunately, insufficient work on purely physical and chemical systems to afford a theoretical basis for the better stating of the problem with reference to living organisms. We find, nevertheless, evidence for an effect on non-living systems, and this we will cite briefly before turning to the purely biological investigations.

A characteristic of living organisms is their power of the asymmetric syntheses of organic compounds. Dhar (1931) reports some success in imitating this effect with polarized light. Solutions of a certain ester were exposed to dextro-circularly polarized light and showed a dextro rotation, while if the light was leavo-circularly polarized the resulting rotation of the solution was in the opposite direction. The greatest effect so far observed is 0.05° on either side. The effect, he notes, agrees in sign with theoretical predictions.

Pospisil (1935) found a special effect of polarized light on Brownian movement. The diffusion velocity of the particle is increased by 18% in the direction of the magnetic vector and by 5% in the direction of the electric vector of the impinging light.

Macht and his co-workers (1925, 1927) have found that polarized light deteriorates certain drugs more rapidly than normal light, and that circularly polarized light produces a greater deteriorization than plane polarized light. The effects were revealed by pharmaceutical tests on animals of the products after irradiation. It is significant that those drugs which were affected by polarized light were themselves optically active.

Semmens (1923) and later Baly and Semmes (1924, 1925) reported an acceleration of starch hydrolysis in polarized light. These observations were confirmed by Macht (1925), Bryant (1923), and Morrison (1925); but criticized by Jones (1925), Bunker and Anderson (1928), and by Navez and Rubenstein (1928).

We may now turn to the effect of polarized light on living organisms.

a) Bacteria and Yeast

Macht and Hill (1925) called attention to the apparent stimulation of the growth of bacteria (*B. coli* and *B. typhosis*) and of yeast (Saccharomyces cerevisiae) in polarized light. Morrison (1925) reported the acceleration of the luminescent cycle of luminescent bacteria by this light. Bhatnagar and Lal (1926) contribute the further evidence that the bacteria of typhoid fever and cholera thrive better in polarized light than in normal light.

b) Fungi

Castle (1933-34) found that the phototropism of Phycomyces in polarized light is different from that exhibited in normal light. This difference could be accounted for on the basis of reflection and refraction differences of the two types of radiation with respect to the cylindrical cell such that when the plane polarized light is parallel to the axis of the cell the total path length and localization of the light within the cell is different both from normal light and from polarized light vibration perpendicular to the cell axis. These physical considerations affecting the actual amount of radiation entering the cell should be considered in any experiments on the irradiation of organisms with polarized light.

c) Plants

Macht (1926) observed an increase in the growth of *Lupinus albus* seedlings in polarized light. Since this effect occurred only when the seed itself was exposed to the light, Macht correlated the effect with an increase in the hydrolysis of starch in the seed by diastase under the influence of polarized light.

Dastur and Asana (1932), however, could find no special effect of polarized light on starch hydrolysis or on photosynthesis.

d) Protozoa

If Paramecia are subjected to visible light of sufficiently high intensity the cells are cytolyzed. When equal intensities of polarized and nonpolarized light were used it was found that cytolysis of the organisms required 1.4 to 1.8 times as long in plane polarized light, (Miller and Tartar, 1935). This differential in lethal effect disappeared when the organisms were photosensitized with eosin, suggesting that the mechanism producing death by photodynamic action is different from that effective in direct irradiation.

NOTES ON BIRD LIFE NEAR WOODS HOLE

We have on the Cape three thrushes: the wood thrush, the veery and the hermit thrush. The first two may be found in or near town, the last more often in extensive woodlands. One of the features of bird life here is the hermit thrushes which sing at their best near Ashmet Lake. At this latitude inland these thrushes nest only at high elevations. Many birds have stopped singing, but not the thrushes.

Young birds are well along giving parents all they can do. The other day I watched a pine warbler plying a young cowbird with mouthfuls as often as every three or four seconds. A pair of red-eyed vireos were similarily engaged. A prairie warbler (uncommon) was feeding its own young.

A virginia rail crossed the road close in front of me. I slowed down for a roughed grouse. Some downy young quail tottered across. Driving along one hears the field sparrow's trill; one notes the white outer tail feathers distinguishing the vesper sparrow, catches many glimpses of flickering wings and snatches of song.

A yellow breasted-chat (a rare bird in this state) may often be heard opposite Gunning Point. A comedian, he delights in jumping from one extreme to another. Much is original, but he throws in calls of the crow, catbird, cuckoo and other birds. Seldom seen, he furnishes entertainment comparable to some radio programs.

Some shore birds you should now find are yellow-legs, turnstones, solitary sandpipers, spotted sandpipers and the rarer piping plover. Note the white in the wings of the spotted sandpipers and the white outer tail feathers of the solitary sandpipers. Its large size, whistle and white tail coverts distinguish the yellow-legs.

A pair of killdeer raised a family near the south end of Walker Street this year. Nearby, a virginia rail and its young were observed. You may hear an explosion of strange sounds as they scoot through the rushes.

The brown young night herons sit in the open with their black-caped parents. A brown bird, of the night heron's size, skulking through the rushes, may be a bittern. —*F. N. Whitman*

The Collecting Net

A weekly publication devoted to the scientific work at marine biological laboratories

Edited by Ware Cattell with the assistance of Anna-Betty Clark, A. S. Cattell, Garnette McClure and Boris Gorokhoff.

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AT THE CAPE COD HOSPITAL

Every member of the laboratory will rejoice that an early Saturday morning report from the night supervisor of the Cape Cod Hospital indicates that Mrs. Robert Chambers and Katerina Zarudny are improving. Although the latter had a "restless" night, her recovery is proceeding in a phenominal way.

Dr. Robert Chambers and Zoya Zarudny will be discharged from the Hospital before the end of the month. Friends of Miss Jennie Massaro will be glad to learn that she, too, will be out about the same time.

We have been asked by Professor Robert Chambers to inform biologists at Woods Hole that he and Mrs. Chambers deeply appreciate their many visitors, but that limitations of facilities at the Cape Cod Hospital make it impractical for them to continue coming in such numbers. He suggests, therefore, that "well-wishers" postpone their visits for several days. We also understand from other sources that many members of the laboratory have driven to Hyannis only to find the number of guests already ahead of them made it impossible for them to see Professor Chambers.

The Cape Cod Hospital is host to five members of the biological community and its facilities are taxed to the limit. Like many similar institutons, it has a history of long and useful service, but is severely handicapped in its work by insufficient money. Would it not be a gracious gesture if a group of members of the laboratory would act as a committee to aid the Cape Cod Hospital in its annual campaign to collect funds which is being initiated during the present month. The Collecting Net would be glad to assist such a committee in any way possible.

THE "MESS" AGAIN

Our recent editorial note on the Mess Hall has provoked much discussion, which in itself is very useful. Some individuals are certain that it was quite "uncalled for;" others consider that it was "too mild." Undoubtedly, the quantity and variety of the food are better than they were last year, but there are few who will dispute the fact that there is still room for improvement.

It has been said that discussion of these problems is outside the scope of The Collecting Net. This we deny. Constructive criticism should be welcomed by all concerned. Where is there another medium in which matters of this kind can be discussed? They would be out of place in the *Biological Bulletin* or in the *Falmouth Enterprise!*

Suggestions presented to administrative boards are, in general, notoriously ineffective without accompanying publication. Presumably the Supreme Court bill suffered severe defeat because the press of the country served as a debating medium.

Affairs of the Laboratory are administered well; it is surprising that, in the face of incessant complaint, conditions in the Mess Hall have not been remedied long ago. Perhaps the controlling officers judge the fare by the annual trustees dinner in August when lobster and other delicacies grace the tables!—*W. C.*

THE CORPORATION MEETING OF THE MARINE BIOLOGICAL LABORATORY

Members of the Corporation of the Marine Biological Laboratory meet on Tuesday to elect officers and trustees. The nominating Committee has suggested Dr. Philip Armstrong, of Cornell University Medical College (just appointed head of the department of anatomy in the School of Medicine at the University of Alabama) to replace Dr. Morgan who retires this year from the Board of Trustees. His long years of association with the Laboratory make his selection an ideal one. The committee undoubtedly gave consideration to the fact that, geographically, the Laboratory is represented only as far south as Nashville. It is appropriate that the contributions of the southern states to biology should receive this increased recognition from her northern neighbors.

Many members of the Corporation, hope, too, that Professor Winston C. Curtis may find a place on the Board. His long experience as a trustee of the Laboratory makes his services invaluable. His contributions to the development of the Department of Experimental Radiology at the Laboratory have been great; his world-wide knowledge of biological laboratories and their "endowers" is equalled by few members of the present Board. So many trustees and other members of the Corporation recognize his outstanding characteristics that it would be a contribution to the welfare of the Laboratory if one of the younger members of the retiring group, for example, Professors Amberson, Goodrich or Speidel would withdraw their names from consideration until next year when Professor Jennings retires from trusteeship. The transfer of the first mentioned from Tennessee to Maryland will bring the number in Baltimore to three. —*W. C.*

ITEMS OF INTEREST

REPORT OF THE NOMINATING COMMITTEE

The following notice is posted on the official bulletin board of the Marine Biological Laboratory:

The Nominating Committee of the Trustees and Corporation of the Marine Biological Laboratory reports the following nominations:

1. For Treasurer—Lawrason Riggs, Jr., to serve one year (to 1938)
2. For Clerk of the Corporation — Charles Packard to serve one year (to 1938)
3. For Trustee Emeritus—T. H. Morgan
4. For Trustees—to serve until 1941

W. R. Amberson
P. B. Armstrong
H. B. Goodrich
I. F. Lewis
R. S. Lillie
A. C. Redfield
C. C. Speidel
D. H. Tennent

The Annual Meeting of the Corporation of the Marine Biological Laboratory will be held in the auditorium of the Laboratory at Woods Hole, Mass., on Tuesday, August 10, at 11:30 A. M., for the Election of Officers and Trustees and the transaction of such business as may come before the meeting.

The vacancy for an instructor in biology at Union College has been filled by the appointment of Dr. Theodore H. Eaton to the position. Dr. Eaton is at present carrying on his research under Professor Alfred S. Romer at the Museum of Comparative Zoology at Harvard University.

Dr. Walter S. Root, associate professor of physiology at the College of Medicine, University of Maryland, has been appointed associate professor of physiology at the College of Physicians and Surgeons, Columbia University.

Dr. Magnus I. Gregersen, previously professor of physiology at the College of Medicine, University of Maryland, assumed in July the position of professor of physiology at the College of Physicians and Surgeons, Columbia University.

Dr. Lloyd Law, who has been at Woods Hole the past seven weeks, left on August 2 for Stanford University where, as a Parker Fellow from Harvard University, he will continue his research in genetics.

Dr. and Mrs. Paul S. Galtsoff returned last Saturday from a trip of several days to the U. S. Fisheries Station in New Haven, Connecticut.

On Sunday evening August 1 a car in which were travelling Professor and Mrs. Robert Chambers and the Misses Katherine and Zoya Zarudny left the road north of Falmouth and collided with a tree. All were injured and taken to the Cape Cod Hospital in Hyannis. Most seriously hurt were Mrs. Chambers and Miss Katherine Zarudny, assistant to Dr. H. Bradley, both of whom sustained skull fractures and other injuries. They gained consciousness on Tuesday afternoon and were said to stand a fair chance of recovering.

Miss Zoya Zarudny, also an assistant in the Marine Biological Laboratory, suffered rib fractures and severe injury of the ankle, while Professor Chambers sustained cuts and bruises about the face and serious injury to the knee, necessitating a plaster cast.

The organization of The Collecting Net Scholarship Association has been completed and it invites the active cooperation of every biologist. Briefly, the primary purpose of the institution is to collect many small sums of money to assist students in embarking on a research problem at one of the marine biological laboratories. The present plans of the Association call for the award of several scholarships for work at the Marine Biological Laboratory. The annual membership fee is $5.00; other classes of memberships are open to those who would like to make larger contributions.

The revival of the whaling industry is foreseen by two seafarers from across Buzzards Bay as they rerig a former lightship as a whaling schooner, hoping to cash in on the rising market for whale oil. One, a descendant of a long line of seafarers and New Bedford whalemen, said, "There are plenty of whales offshore between Nantucket and Hatteras. We shouldn't have any trouble catching them; they have not been chased in a long time."

CURRENTS IN THE HOLE

At the following hours (Daylight Saving Time) the current in the Hole turns to run from Buzzards Bay to Vineyard Sound:

Date	A. M.	P. M.
August 10	7:39	7:56
August 11	8:22	8:50
August 12	9:09	9:37
August 13	9:56	10:33

In each case the current changes approximately six hours later and runs from the Sound to the Bay.

THE MARINE INVERTEBRATE COURSE OF THE M. B. L.

Dr. T. Hume Bissonnette

Instructor in Charge; Professor of Biology, Trinity College

This course differs from the courses on Invertebrates usually given at Universities and Colleges throughout the country in that its objectives are at least three-fold while theirs are almost entirely morphological or studies of comparative anatomy.

This course presents enough of the comparative anatomy of the invertebrates, learned by observation and dissection of the conventional forms along with much more varied materials than are possible in most colleges, to enable those who have not taken such courses to study at first hand the fundamentals of invertebrate structure. For more advanced students, it furnishes a review of this with plenty of living material. Secondly, from the study of many forms in the living and active condition, the general behavior and physiology of these forms are brought to the attention of students. Perhaps the most important part and objective of the course is the study of animals in the field in their various habitats and associations. This enables students to learn by name and to recognize at sight many of the more common or interesting species native to the district and to become conversant with their specific characteristics and classification. This is facilitated by the use of condensed keys for rapid identification of common species belonging to the various phyla. These keys have been prepared by members of the staff of the course. This part of the course lays a foundation for the more specialized courses in Protozoology, Embryology, Physiology and Ecology.

This third part of the course is presented on field trips for which the class is divided into six teams. Each member of a team is taught to use one or more implements on each trip to aid the team in finding, identifying and learning the habits and preferred habitats of a comparatively large number of species in each region visited. Each team of nine or ten students is accompanied and directed by a different instructor on each excursion. These instructors are interested in different aspects of biology and in different groups of animals. So the method of attack upon the problems in the field, as in the laboratory, differs with different instructors. Each team comes under the influence and guidance of at least six different members of the staff on field trips and of nine in the laboratory.

The animals of the different phyla will be studied in the following order, though not all the groups here listed are listed separately on the program of the course;—Marine Protozoa, Porifera, Coelenterata, Ctenophora, Platyhelminthes, Nemertea, Nematoda, Annelida, Mollusca, Arthropoda (including Limulus), Bryozoa, Echinodermata, and the lower Chordata of the region.

Special lectures on Marine Ecology, Marine Zoology and Invertebrate Phylogeny will be given by members of the staff and, if possible, others by scientists working or visiting at the laboratory. Dr. Oscar Richards is showing moving pictures of the Coelenterates and Tunicates of the reefs at the Tortugas.

If weather permits, collecting and study trips will be taken to the following localities;—Lackey's Bay, the Breakwater Beach, Kettle Cove, Lagoon Pond Bridge near Vineyard Haven, Hadley Harbor, Cuttyhunk, North Falmouth and Tarpaulin Cove, where varied habitats are near enough together to make it possible to study several in a short time while the tide is low. Students will also spend half a day studying animals freshly dredged from different parts of Vineyard Sound. Students see how the dredging is done and how the animals studied are associated with each other and with the various types of sea-bottom.

There have been some changes in the staff since last summer. Dr. Olin Nelsen is on leave of absence for the year and his group is being taken by Dr. Sears Crowell. Dr. Crowell's place is being filled by Dr. Stewart Rankin of Amherst College, who was associated with the course as laboratory assistant some years back and has lately been a member of the collecting crew of the Supply Department. The rest of the staff is the same as is shown in the Annual Announcement of the Marine Biological Laboratory.

LOUISIANA STATE UNIVERSITY FIELD LABORATORY

Professor E. H. Behre, *Director*

The main purpose of the Field Laboratory is to give marine biological experience to the advanced graduate and undergraduate students of Louisiana. Since the equipment, facilities and work plans are very modest we prefer to be called a field station or biological camp rather than a biological laboratory. Professor E. W. West is in charge of a course in plant ecology; elementary ornithology and entomology are taught by C. Wallace McNutt. The author presents a course on general zoology and another on zoological problems. During the present summer we have no permanent research workers except our advanced graduate students who are beginning research projects: Jess C. Anthony on problems in cross fertilization of certain Pisces; C. Wallace McNutt on the embryology of the southern squid; Lyle St. Amant on the biology of the oyster drill; Monroe Young on the echinoderms of the Grand Isle region; Si Ward on a further extension of studies of Grand Isle birds.

NOTES AND NEWS FROM M. B. L. CLASSES

BOTANY CLASS NOTES

The incoming botany class rounded out its fourth day with a perfect introduction to the true sources of fresh water algae. After gazing hopefully into our microscopes for three days, searching the wide spread field of the microscope's revelation we set out to bigger and better fields. Well prepared with clean bottles, spotless collecting kits, semi-clean hiking outfits we started out at a pretty pace through the town. A visit to a pond and a ditch dampened our feet. A visit to Chora Pond (don't let the name deceive you, it's really a bog) dampened our legs and filled our shoes with beautiful specimens of slime. A long walk from the slime to our next point of interest dampened our spirits. [Incidentally, we should have a track team up here. Some of the professors should give excellent competition.] But oh, the final dampening. For pure clean fun you really should enter Cedar Swamp. We were half submerged in plant life that had taken to water as we had. Along with these plants are found mud and more mud.

Home again we resumed our study of algae life under our microscopes. A race two hours long, finished up the afternoon. The race was conducted with the class divided into three groups. That group which located and named the greatest number of genera won.

In class we have been studying Chlorophyceae with Dr. Prescott the morning lecturer. We are now looking forward to further collecting trips with lectures on Phodophyceae and Rhaeophyceae by Dr. Taylor; lectures on Myxophyceae and Xanthophyceae by Dr. Drouet. Dr. Prescott will do more lecturing on diatoms and chorales.

—*J. P. H.*

INVERTEBRATE CLASS NOTES

As successors to the class of embryonic zoologists, fifty-seven back-boneless protégés have carried on the tradition in the laboratory in Old Main. For four days protozoa, porifera and coelenterata have been sole table topics and an excellent means of introduction to both the course and our fellow workers.

Under the leadership of Dr. Bissonnette, the invertebrates were rapidly initiated into the minor complications of the course and were carried into a flying start by Dr. Waterman. His lecture inspired us to seek many an elusive protozoan. The sponge expounded by Dr. Sayles and the jelly fish held aloft by Dr. Crowell were the next objects of day and night investigation. Not even the Sabbath was a lull in the activities of man and unicellular beast. But Monday produced a much anticipated occasion, our first field trip to Lackey's Bay aboard the *Winifred* and *Nereis*. Angels and ark angels hobnobbed with mud grubbers and stone lifters while identification of specimens was relegated to the leaders in charge.

With feverish expectation we await our next wading expedition, a second great treat in our first week of many happy hours.

—*S. W.*

ADDITONAL INVESTIGATORS

Addison, W. H. prof. hist. & embr. Pennsylvania. Br 304. Gosnold.

Brehme, Katherine S. ed. asst. Genetics. Br 314. Sylvia, Buzzards Bay.

Dienes, Priscilla techn. asst. Dr. Tyler. Br 315. W C.

Dryer, W. A. asst. prof. zool. Cincinnati. Br 334. D 312.

Fraser, Doris A. res. fel. anat. Pennsylvania Med. Br 304. H 7.

Gottschall, Gertrude asst. biochem. Cornell Med. Br 121. H 3.

Howell, C. D. grad. zool. Johns Hopkins. Br 217. Robinson, School.

Jones, N. instr. sci. drawing. Swarthmore. Br 211. A 201.

Kille, F. R. asst. prof. zool. Swarthmore. OM 31. D 206.

Lewis, Lena res. asst. phys. Ohio State. Br 108. Lyons, Main.

Magruder, S. R. asst. anat. Cornell Med. L 30. Neal, Bar Neck.

Newton, W. H. reader phys. London. (England). Br 303. A 108-9.

Root, W. S. assoc. prof. phys. Maryland Med. Br 225. Brooks.

Spencer, W. P. visit. prof. genet. California Inst. Techn. Br 332. Thayer, Falmouth.

Tartar, V. asst. zool. Yale. Br 323. Hamblin, Little Harbor.

Osterud, K. L. grad. asst. biol. New York. Bosworth, North.

Perry, Dorothy Smith. W G.

Ramsey, Helen J. Purdue. H 4.

Reed, Eleanor grad. biol. Pittsburgh. Norton, Quisset.

Rockstein, M. Brooklyn. Dr 1.

Ryan, F. J. Columbia. Dr 5.

Sawin, H. J. grad. asst. zool. Harvard. Frawley, Main.

Schneider, Ruth M. Skidmore. H 1.

Stearns, J. B. Amherst. Dr 5.

Steele, D. G. asst. prof. genet. Connecticut State. Dr 7.

Strandine, E. J. grad. zool. Northwestern. Dr 1.

Sugarbaker, J. D. teach. sci. Whippany Jr. H. S. (N. J.). Chase, North.

Swanson, C. P. Massachusetts State. K 7.

Walker, Sally Radcliffe. Grinnell, North.

Ward, Elizabeth B. grad. asst. zool. Cincinnati. Robinson, Quisset.

Williams, Myra grad. asst. zool. Duke. W H.

Wilson, J. G. grad. asst. biol. Richmond. Ka.

STUDENTS IN INVERTEBRATE ZOOLOGY

Albrink, W. S. Oberlin. K 5.
Bailey, Villa E. Oberlin. H 7.
Baird, Isabell. Mt. Holyoke. Stuart, School.
Barren, A. A., Jr. grad. zool. Northwestern. (Oak Bluffs).
Barkley, Mabel A. teach. biol. Central H. S. (Washington, D. C.). Bosworth, North.
Berry, C. M. De Pauw. Albany, Millfield.
Bookhout, C. G. instr. zool. Duke. D 112.
Bottom, C. H. asst. prof. biol. Centre. Dr 7.
Bridgman, Josephine assoc. prof. biol. Flora Macdonald. (N. C.). H 7.
Burbanck, W. D. instr. zool. Earlham. (Ind.). Chase, North.
Carroll, W. R. Swarthmore. Ka 3.
Culberson, Mabel H. teach. sci. State Normal (Me.). H 1.
Dana, Harriet M. Swarthmore. H 7.
Dvoskin, S. City College. Cahoon, Main.
Eisenberg, Esther lab. asst. biol. Eastern District H. S. (N. Y.). Nicholson, Main.
Evans, H. J. Hamilton. Ka 3.
Fink, H. K. Princeton. Robinson, Quisset.
Gilman, L. C. grad. zool. Johns Hopkins. Ka 4.
Goodchild, C. G. grad. asst. zool. New York. Avery, Main.
Goodline, Mary. New Jersey State Teachers. H 6.
Gortner, R. A., Jr. grad. biochem. Michigan. Dr 1.
Griffin, D. R. Harvard. (Barnstable).
Hamilton, H. L. Iowa. K 5.
Harrold, C. M. asst. zool. Wabash. Albany, Millfield.
Haskin, H. H. grad. asst. biol. Harvard.
Holthausen, C. F., Jr. Amherst. K 6.
Johnson, Marian W. American. Nicholson, Main.
Kuhn, Evelyn M. res. asst. biol. Rice Inst. Ferris, Glendon.
Kurtz, Elizabeth H. Wilson. H 9.
McBride, Margaret Pennsylvania Col. for Women. H 4.
Mapp, F. E. teach. biol. Washington H. S. (Atlanta). Dr 3.
Marrow, Lucille teach. biol. Jamaica H. S. (N. Y.). H 3.
Martindale, Florence M. instr. zool. Mt. Holyoke. Smith, East.
Merwin, Ruth M. Mt. Holyoke. Smith, East.
Miller, A. instr. ent. Cornell. Sylvia, School.
Müller, Filomena grad. zool. Minnesota. Cassidy, Millfield.
Müller, W. A. grad. asst. zool. Minnesota. Cassidy, Millfield.
O'Brien, J. P. res. asst. Hopkins. Mendel, High.
Orange, Jeanette res. mammalogy. National Museum. (Smithsonian). W C.
Scrimshaw, N. S. jr. asst. zool. Ohio Wesleyan. Elliot, Center.

TWENTY-TWO TURKEYS MAKE ONE DINNER

"Grammy" Coombs Feeds 400 Folks Every Day at M. B. L. Mess Hall

(From the Falmouth Enterprise)

"Grammy" Coombs has been feeding people for nearly half a century. For forty years she has been catering to the appetites of M. B. L. students, professors and staff members. She has seen a lot of food during her long life as kitchen helper, cook, and supervisor. Friendly, and energetic for her years, she runs the M. B. L. mess hall during the summer months. Her patrons know her as "Grammy" Coombs; her correct name is Mrs. Nellie E. Coombs.

It is some task to feed a hungry group of scientists. More than four hundred people are eating now at the M. B. L. mess hall, and, as Mrs. Coombs says, "that means more than four hundred different tastes to satisfy. I can't satisfy them all at once, so I watch what they eat and try to maintain an average."

Four hundred persons consume an enormous amount of food. Mrs. Coombs buys 12 cases of eggs and 240 pounds of butter a week. The four hundred need 157 pounds of beef, 165 pounds of swordfish, and 22 turkeys each time those articles appear on the menu. Every morning the milkman leaves 30 eight-quart cans of milk for drinking, two eight-quart cans of cream and sometimes one or two twenty-quart cans of cooking milk. Fifty loaves of bread are required each day and it takes 18 gallons of ice cream for a single dessert.

Mrs. Coombs needs a sizeable staff to help her prepare and dispense all this food. Twenty-one boys and five girls work as waiters, one student attends to the coffee and one the milk. They receive their board as compensation. Thirty-three paid workers prepare the food and do the cleaning up.

Tastes haven't changed much during the past 40 years, according to Mrs. Coombs. She believes people eat more now, though. She says, "I've noticed lately that people eat a lot of salads, and more vegetables than they used to, but I don't notice them eating any less meat, and they've always liked desserts. And another thing I've noticed is that you can't make people learn to eat what they don't like. They get along better when they eat what they do like."

Salads are popular at the M. B. L. mess. Mrs. Coombs serves at least one salad a day. Turkey is the favorite meat with steak a close second. Sometimes she hears her boarders say they don't get enough milk, although each drinks at least a pint a day besides coffee and other beverages. Ice cream is the favorite dessert, with chocolate cake second and pies third in favor. Mrs. Coombs is surprised so many people eat eggs. She doesn't like them herself. M. B. L. eaters don't mind being served hash.

The M. B. L. mess hall is one of many places where Mrs. Coombs has worked. She has usually been able to dovetail her duties in Woods Hole with work at institutions which cater to students and tourists during the fall, winter and spring. She has worked at Swarthmore, Bryn Mawr, the Lake Placid Club, at Wachusett mountain and at the Episcopal School in Cambridge. On her desk is a beautiful clock on which is engraved, "Mrs. Coombs in grateful appreciation from the Stuart Club girls 1906-1935." The Stuart club is a fashionable boarding place for girls in Boston where Mrs. Coombs says, "They pay $25 a week for board."

Mrs. Coombs has borne the nickname of "Grammy" for a long time. An Irish boy working for her was responsible for it, the waiters soon picked it up and now everybody uses it. She bears the nickname well. She is easy to talk with and has a friendly voice. She won't reveal her age. To her, age is determined by ability to work, and Mrs. Coombs is a lively person.

She is proud of the number of friends she has all over the world. The M. B. L. population is a cosmopolitan one and she says that "whenever people who have been here return to Woods Hole they always drop in and see me." Her home is with her son John in Watertown. He works in Boston and is a frequent visitor in Woods Hole during the summer. His wife is at present one of her assistants.

And Mrs. Coombs is very fond of Woods Hole. "It is pleasant, clean and good for health," she says, the sparkle in her eyes emphasizing her comment.

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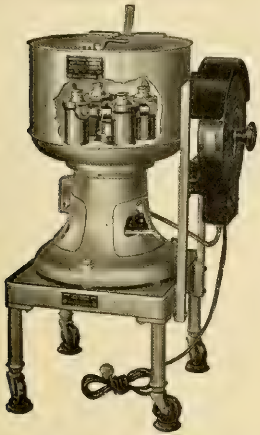

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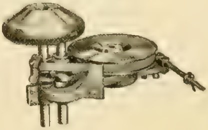

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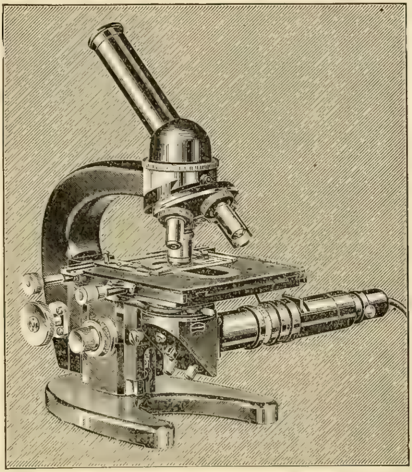

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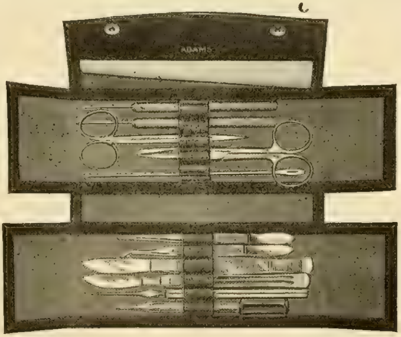

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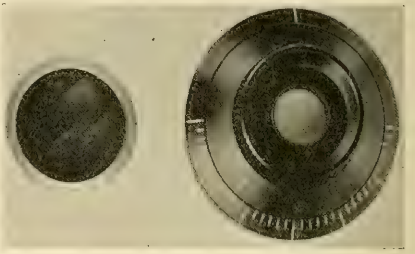

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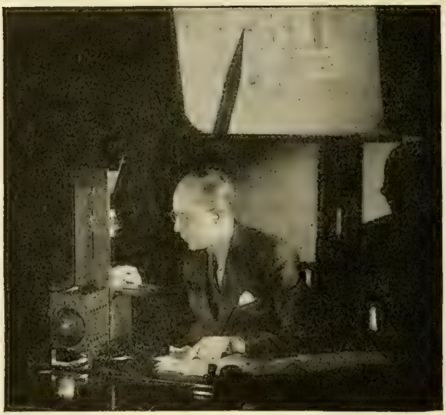

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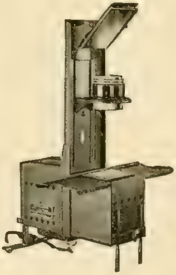

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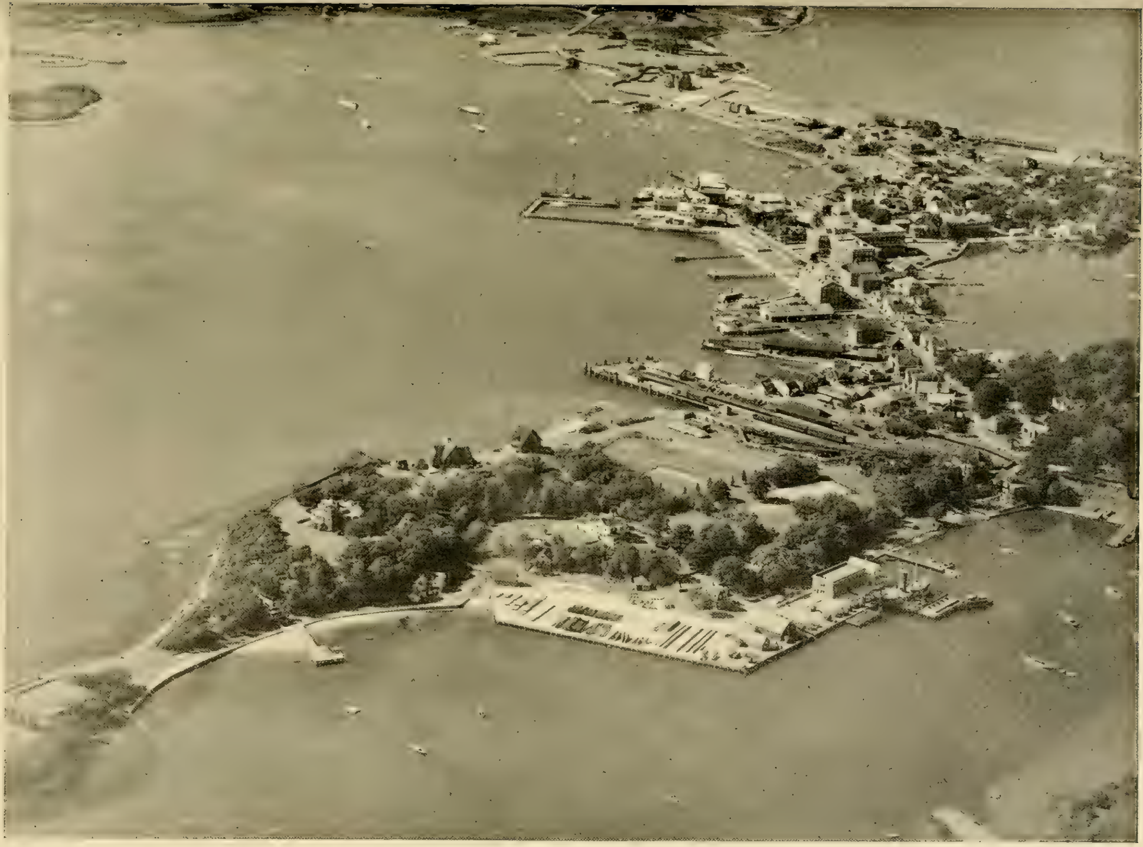
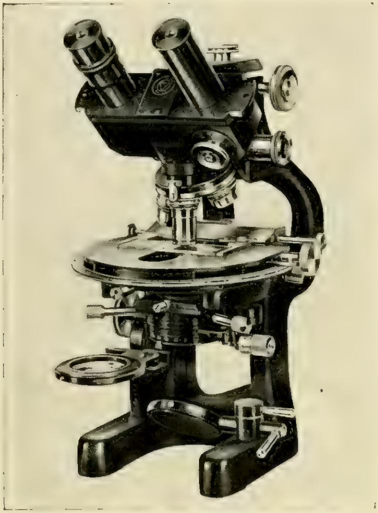


AIRPLANE VIEW OF WOODS HOLE

with Juniper Point, the Buoy Yard, and Little Harbor in the immediate foreground. The biological laboratories are in the center of the upper right-hand corner.



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THE COLLECTING NET

Vol. XII, No. 7 SATURDAY, AUGUST 14, 1937 Annual Subscription, $2.00 Single Copies, 30 Cents.

THE 1937 MEETING OF THE CORPORATION OF THE MARINE BIOLOGICAL LABORATORY

Dr. Charles Packard
Clerk of the Corporation

The outstanding feature of the 50th annual meeting of the Corporation was the announcement of Dr. Jacob's resignation as Director of the Laboratory. Dr. Jacobs was appointed to this office in 1926 and has filled it with distinction for 11 years. Now he asks to be relieved of his duties so that he can devote more time to research. The members of the Corporation, by a rising vote, expressed their hearty appreciation of his long-continued and faithful service.

The election of officers resulted in the reappointment of Lawrason Riggs, Jr., as Treasurer and Charles Packard as Clerk of the Corporation.

Professor T. H. Morgan was made trustee emeritus.

The Nominating Committee presented the names of eight candidates for election as trustees. Dr. Caswell Grave added the name of W. C. Curtis, who served as trustee from 1923 to 1936. In order to create an additional vacancy and thus avoid a contest, Dr. (*Continued on page* 159)

M. B. L. Calendar

TUESDAY, August 17, 8:00 P. M.

Seminar: Dr. A. Tyler and Mr. N. H. Horowitz: "A Sea Water Buffer for Marine Eggs."

Mr. E. C. Black and Dr. L. Irving: "The Effect of CO_2 upon the Oxygen Capacity of the Blood."

Dr. I. M. Korr: "Oxidative Mechanisms in the Resting and Fertilized Sea-Urchin Egg."

Dr. K. G. Stern and Dr. D. DuBois: "The Application of Rapid Chemical Reactions to the Kinetics of Enzyme-Substrate and Enzyme-Inhibitor Compound Formation."

WEDNESDAY, August 18, 8 P. M.

Lecture: Dr. R. C. Murphy: "The Gates of the Antarctic."

FRIDAY, August 20, 8:00 P. M.

Lecture: Dr. H. C. Stetson: "The Submarine Caverns of the Continental Shelf."

A GENERATION'S PROGRESS IN EMBRYOLOGY

Dr. E. G. Conklin
Emeritus Professor of Biology, Princeton University

Although you may find yourselves a trifle crowded this morning in this room, I asked to be permitted to lecture here rather than in the auditorium of the brick building because this is the place where so many leaders in embryology have continued to work and to lecture for many years past; for that reason it seems to me a sort of shrine, one which I fear is not likely to persist indefinitely but which will be forever enthroned in memory. Reminiscence is one of the things which is usually permitted to old persons; consequently I assume that you will permit me to do a little reminiscing this morning regarding the work in embryology with which this Laboratory has been especially connected. You younger people can take care of the forecasts for the future, so I shall tell you something of what has been done in the past, memories of which I have clearly in mind. I am professionally an embryologist and my professional life coincides almost exactly with the life

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WOODS HOLE IN HALF-TONE

Left to right: **Top row,** Snapshots of basking shark killed at Hadley Harbor (see "Collecting Net" for July 24, 1937); **Second row,** the same shark; Joe Carmichael, Kay Robertson, Ted Morgan and Dick Fennel on Mess Hall steps in 1936 (Weber); Barbara Leonard, embryology class reporter for "The Collecting Net"; Dr. Chas. Packard; **Third row,** the M. B. L. brick building and Kidder House (Weber); Mr. R. A. Goffin, superintendent of the U. S. Bureau of Fisheries station in Woods Hole; Dr. H. B. Goodrich; Dr. and Mrs. Albert Tyler; **Fourth row,** Piers off the Marine Biological Laboratory (Weber); the famous Class J1 sloop, "Rainbow," before Penzance Point at dusk (Copeland); Dr. E. V. Cowdry; Dr. Caswell Grave.

(Photographs not credited are "staff pictures" taken with a Zeiss Ikon Super Ikomat).

of the Marine Biological Laboratory.

I. *The Recapitulation Theory.*

After the publication of Ernst Haeckel's great book entitled "Generelle Morphologie," which appeared in 1866, there came to be an intense interest in embryology from the evolutionary point of view and from the year 1870 down to the year 1890, shortly after the founding of this Laboratory, embryology was studied with the idea of learning what the course of past evolution had been. It was claimed, according to Haeckel's fundamental law of biogeny that ontogeny is a brief recapitulation of phylogeny; correspondingly everyone was engaged in trying to find out what the phylogeny of various animals and plants had been by the study of ontogeny. I was a graduate student at the Johns Hopkins University and my professor there was convinced that ontogeny was a short history of phylogeny so his students were engaged in searching out the ancestry of various phyla of animals by means of their embryology.

The great mystery was with regard to the origin of vertebrates, and some of the most extraordinary views were brought forward. One English scientist, Adam Sedgwick, whose translation of Claus's textbook you may have seen, put forth the extraordinary opinion that the vertebrates had descended directly from a coelenterate, comparable, let us say, to Metridium; that the siphonoglyphs, of which there are two, formed one the mouth, and the other the anus and that the septa became partitions between the metameres. Almost every phylum that was studied was regarded by the man who was studying it as at least a possible ancestor of the vertebrates. The nemertians were taken as ancestors because they have a proboscis and a proboscis sheath which was supposed by Hubrecht to be the beginnings of the notochord. The annelids were especially favored as the ancestors of the vertebrates, particularly by Anton Dohrn, founder of the Naples Zoological Station. He maintained this most strenuously and others followed in his steps.

If you are interested in some of this ancient history you will find in the library a set of volumes, some nine or ten in number, published in the decade from 1890-1900 and entitled "Biological Lectures from the Marine Biological Laboratory, Woods Hole, Mass." Almost every year in that decade there was issued a volume including selections from the evening lectures that had been given. They represent an excellent summary of current opinions and research work in progress at that time. In the first volume, for 1890, Professor E. B. Wilson gave a lecture on "Some Problems of Annelid Morphology." What were the problems of Annelid morphology? First of all, the relations of the annelids to the vertebrates. Secondly, the origin of metamerism, of the jointed character of the worm, a subject which has been long discussed and has never been, I suppose, fully settled. Many people supposed that it was absolutely necessary that vertebrates should come from segmented animals; segmentation was supposed to be a very original, primitive character; it was a physiological problem, as well as a morphological and evolutionary one. In the third place he studied the method of forming the embryo, namely concrescence, which you see is getting nearer to the physiological aspects of modern biology. There are a great many resemblances between annelids and vertebrates and there are a great many resemblances between arthropods and vertebrates. The fact is that all living things are related more or less and that there are certain things which are fundamental to all; it is not surprising to find that in certain fundamental characteristics they resemble one another.

A second lecture in this first volume shows this same tendency to use embryology as a key to past evolution. It was by Professor J. P. McMurrich, one of the early workers here in this Laboratory. It used to be said of him, "McMurrich is nursing the animal kingdom!" His lecture was entitled "The Gastraea Theory and Its Successors." Now I hope most of you have never heard of the Gastraea theory, for it occupied entirely too much time in that period. It was another one of Haeckel's theories and postulated that there were living in some distant Paleozoic era, free-swimming gastrula-like forms, the Gastraea, which never developed beyond that stage and that the metazoa were derived from them. I will later point out that there are many elements of truth in all of these ideas. The gastrula stage is one of the latest periods in ontogeny in which you can find resemblances which extend throughout the entire range of Metazoa. There were many other of these hypothetical ancestors. One of them went back of the gastrula to the blastula, and the free-swimming ancestors in this case were called Blastaea.

One who shook off these ideas a little later but was at that time also working along lines of recapitulation was Professor T. H. Morgan. His lecture in the first volume was on the ontogeny and phylogeny of the sea spiders, but he did not attempt to touch upon the origin of the vertebrates. Many of you know of the work of the late William Patten, which was the most detailed attempt to establish relationship between invertebrate and vertebrate, based upon embryology, that has ever been made. He studied extensively, and with splendid results, the embryology of Limulus. He became thoroughly convinced that Limulus or a Limulus-like creature was the ancestor of the vertebrates and he wrote a great book on "The Origin of the Vertebrates and their Kin." I remember a long session I had with him on one occasion. He was about to publish his book and the publisher evidently was a little in doubt about some points, so he asked me to go over it with him. He had really contributed a great deal of fine quality but with the enthusiasm of one carried away with his subject he wanted to derive the whole animal kingdom from that one ancestor. When it came to deriving the star-fish from Limulus, I said "Don't you think it will be sufficient to derive the vertebrates from Limulus?" But he said, "No sir! This is one of the best things in my theory."

I had begun work on Crepidula in 1890 and some people said, "Why don't you get Crepidula into our ancestral line?" But I never could do it; however, I had sometimes speculated on how nice it would be to convert a squid into a vertebrate. Just think of the possibilities! Figure them out for yourself. It is merely a matter of imagination and fancy. Watase, a Japanese worker, was here at that time and was working on the squid egg, studying "karyokinesis," and realizing that much of this recapitulation work was based upon fanciful homologies, he said to me, "I am done with this whole phylogeny business. Embryology is no longer to mean a search for phylogeny."

II. *Cell-Lineage and Cell-Homology.*

Until the year 1890 or 1891 the earliest homologies that had been studied in comparing various phyla were to be found in what we called the germinal layers, the ectoderm, the mesoderm and the endoderm. The germ layer idea was the thing, in the beginning of the 90's, which occupied most of the attention of the embryologists of the time. I recall very well that as a student, before I had selected a subject for a doctoral thesis, I got to thinking of the variety of opinions that had been expressed concerning the origin of these germinal layers from the egg and I said, "Why doesn't someone make a very detailed study of this matter in some favorable material, and find the way in which these layers come out of the egg?" I came to Woods Hole with that in mind and I also began to "nurse the animal kingdom." I knew none of the people here and was isolated for the first year over in the Fisheries Bureau, but I had plenty to work on and I can't begin to tell you the way in which I broadcast in every direction for favorable material. One day I found some egg masses of Crepidula and saw that they were particularly favorable for just the thing I was after. That started me on the course which I have never left, though I have sometimes taken some little side excursions. I am still working on Crepidula development and shall probably take it with me to the next world, where I hope there will be plenty of Crepidulas.

It seems that Professor Wilson was, without my knowledge, engaged in the same quest. He was here in 1890 studying the cell origin of the germ layers of Nereis and I went through the year without having met him. I heard the lectures and met a few men at the Marine Biological Laboratory, but I did not venture to talk with the demi-gods. I made out a thesis, which I offered to Professor Brooks, on the embryology of Crepidula. Brooks shook his head over it. He did not have any confidence in the homologies that preceded the gastrula stage. He said to me, "There is no morphological significance (and by this he meant homology) in the mere duplication of parts and cleavage is nothing but the duplication of cells. Morphology does not begin until you get to the germ layers." Years later, after a great many people had begun to study cell lineage, I went to Beaufort, where Caswell Grave was in charge of the station. He met me on the wharf and said "Brooks is here. And you have your revenge! He's working on the cell lineage of the oyster."

Finally my thesis was accepted in 1891 and I came back to Woods Hole. Watase told Professor Wilson of what I had been doing on Crepidula and he told me of what Wilson had done on Nereis. At last Wilson and I spent a Sunday together and what a Sunday it was! The enthusiasm of that day fills me with joy just to think of it, even now. He was working on an annelid, I was working on a gasteropod and yet when we compared our results they seemed incredibly alike. The mesoderm came out of a single cell of the fourth quartet on the posterior side of the egg, the ectoderm came out of three quartettes of cells nearest the animal pole, the endoderm from four large cells, the macromeres, at the vegetative pole. I found that there were in Crepidula two other small cells that came from the mesoderm cell and that give rise to the gut, posterior to the stomach. Professor Wilson did not find these; that was a disappointment. However, a few years later he found rudimentary cells in Nereis that corresponded precisely to these functional cells which give rise to the intestine in Crepidula. And I found certain rudimentary cells in Crepidula that

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THE COLLECTING NET has been entered as second-class matter July 11, 1935, at the Post Office at Woods Hole, Massachusetts, under the Act of March 3, 1879. It is devoted to the scientific work at marine biological laboratories. It is published weekly for ten weeks between June 1 and September 15 from Woods Hole and printed at The Darwin Press, New Bedford. Its editorial offices are situated on the third floor of the Woods Hole station of the United States Bureau of Fisheries. Between June 1 and October 1 communications should be addressed to Woods Hole, Massachusetts; at other times they should be directed to THE COLLECTING NET, Garrison, N. Y. Single copies cost 30c; a subscription (containing not less than 280 pages) costs $2.00.

corresponded to functional ones in Nereis. We found in the ectoderm certain arrangements of cells that corresponded in Nereis and Crepidula. In the mollusc the velum comes from some of the same cells as the prototroch of the annelid. These remarkable resemblances before gastrulation and the formation of the germ layers led to an epidemic in the study of cell-lineage, as Professor Wilson so aptly termed it. This Laboratory became *the* center in all the world for this study. Many people felt that we had gone crazy over it and perhaps we did go too far in seeking these cell homologies. But in any event a great deal was accomplished in learning about the origin of the germ layers and of the differentiation of the various blastomeres.

In the meantime there came up a new line of work in embryology which was, I suppose, one of the most important in its results of all the work of the last fifty years. It was largely due to a young German, Hans Driesch. In 1891 he published some work which he had done at the Naples Station. He had broken apart the blastomeres in some Echinid eggs and found that from one of the first two blastomeres, he could get a whole larva; even from one of the first four and from one of the first eight (according to his original ideas) he could get a whole larva. He came to the conclusion that there is no differentiation going on in cleavage, that the egg is homogenous and all the cells alike. As he said, the blastomeres are like balls in a pile; they can be transposed in any way and yet they are equipotential in their powers of development.

However, cell-lineage students found that they were not all alike, and later Driesch changed somewhat his point of view and said that it may be true that in some cases the cells have prospective meaning or significance; there is a prospective fate for every cell if it remains in its original position, but this prospective "Bedeutung" is not necessarily the same as the prospective potency. What is the prospective potency of cleavage cells? He maintained that they were capable of giving rise to the entire embryo. That simply went counter to all the cell lineage work that had been going on here. How in the world could we fit these facts into the results of cell lineage? We all went around shaking eggs and this whole Laboratory was known as a laboratory of "egg-shakers."

We broke the blastomeres apart and studied the result on development. In the annelids, the molluscs, the ascidians and a few other forms, it was quite plain that the same thing did not take place that Driesch had found in the echinoderms. We did not find that these blastomeres were totipotent. However, Driesch was not at all convinced and years later when I had made similar studies on ascidians and had shown that in the development of the ascidian egg, as in the mollusc, these cells are already, at an early stage, so differentiated that they will not give rise to an entire embryo. Driesch gave me a severe drubbing and insisted that he had worked on the ascidian egg and that the eggs of the humble ascidians of Europe were not as spectacular as those of America; that America, as usual, had the most remarkable ascidians, but that my findings did not apply to the ascidians of Europe. I took the challenge and went to Naples to study Driesch's ascidians and found that they develop like those at Woods Hole. I found that a half blastomere does not give rise to a whole larva, much less a quarter. This conflict of opinion went on a long time and echoes of it are still heard, but as is usually true in scientific progress, there are elements of truth in almost every proposition or theory that has been carefully studied and maintained by many persons through a number of years. The same can be said for this subject of the differentiation of blastomeres, both of the views are true. Sometimes blastomeres are so highly differentiated that they cannot undergo dedifferentiation in order to start off anew; and in other cases the reverse is true. They are either very little differentiated at the time they are separated from each other, or they are capable of starting over again so that they can give rise to the whole embryo.

III. *Egg Organization Before Cleavage.*

I want especially to cell attention to some of the other significant lectures that were given here at the Laboratory in later volumes of the Biological Lectures. In 1893 Professor Whitman, Director of the Laboratory, published in the volume of Biological Lectures for that year, a paper which he had given at the World's Fair Congress in Chicago, which was stimulated directly by the controversy that was going on between the experimentalists and the observationalists concerning the early blastomeres and their fate. He entitled it "The Inadequacy of the Cell Theory of Development." In it he pointed out clearly a theory which has come, in more recent times, to occupy a great deal of attention. It is known today as the "Organismal Theory." Whitman maintained that organization was already established in the egg. Certain areas were localized to form ectoderm, endoderm, etc., and that cleavage might go in various directions without changing the original organization.

This lecture was followed by another by McMurrich on "Cell Division and Development" in which he quotes a sentence from Julius Sachs —"Plants make cells, not cells plants." The cells of the egg do not make the animal, the animal makes the cells of the egg. It is the organismal theory again. If the animal is there in the organization of the egg, in the various substances present, these may be divided up into cells which are similar in fate, in some cases, or they may be different in others. That was the idea that was also put forth by Professor Loeb in a book, "The Organism as a Whole."

My suggestion at that time for solving the difficulty was published a couple of years later, 1897, in the volume of Lectures, namely that differences in the significance of cleavage in different animals depend on the time at which differentiation takes place; in certain eggs it takes place very early, in others relatively late. Where differentiation takes place early, the cleavage is of the determinate type and where it takes place late, cleavage is of a more indeterminate type; that the determinate type usually leads to a mosaic type of development, whereas the other leads to an equipotential type. Later study of the echinoderm egg, especially by Hörstadius, shows that its cleavage is not as indeterminate as Driesch supposed.

Finally, in this carrying back of organization into the egg itself I was fortunate enough to stumble upon an extraordinarily favorable object. I suppose that accident has played a great part in most scientific progress. I was looking for a "good egg" and I recall that on the Fourth of July, 1902, Professor Morgan and I went over to Little Harbor and scraped the piles at the buoy wharf and came back with a lot of miserable little ascidians. I found that they have pigmented eggs and thus I got started on my "Organization and Cell-Lineage in the Ascidian Egg." I was able to make a sort of geographic map of the egg before cleavage and I found that its development was of the mosaic type. Then Lyon introduced the use of the centrifuge to separate egg substances that were of different specific weights. That began in 1906 and everybody turned from egg shaking to "egg grinding" and the results were very interesting. It was found that most of the visible substances such as yolk, pigment, mitochondria, etc., are not necessary parts in the formation of the embryo but that the hyaloplasm, the clear protoplasm, is the important part. An embryo develops quite normally with displaced yolk pigment and so on, but when I centrifuged ascidian eggs hard enough to displace portions of the ground substance or hyaloplasm, I got all kinds of abnormal development. It was possible thus to get notochords and endoderm on the outside of the body, eyes in the middle of the body, muscles and muscle fibrillae appearing wherever the muscle material had been thrown. Indeed these substances could be separated so that the parts into which they developed were practically conformable to what Virgil calls in the Aeneid "membra disjecta." That only confirmed our old idea that there are, in the egg, substances which are organ-forming or morphogenic and other substances which are easily separated and are not organ-forming.

IV. *Evolution and Epigenesis.*

In 1895 Professor Whitman gave a series of three lectures here, a phenomenal thing, for he was not a frequent lecturer. He used to say that any teacher who gave more than one lecture a week was wasting his time and that of his hearers. He published these three lectures in the volume for 1895. The leading one, which I recommend all of you to read, is entitled "Evolution and Epigenesis." This is a philosophical discussion of real importance today. It used to be thought that there was present in the human egg a little man, the homunculus, already preformed. C. F. Wolff showed in 1759 that this was not true, that there was no preformed organism in the egg. Yet in some way it was necessary to get an animal out of the egg. If the egg starts out without organization, when and how do you get that into the egg? If one believes, as Wolff did in 1759 and as Alexander Goette did down to the year 1874, that the egg is unorganized and becomes organized only through the influence of the spermatozoon, then it might be maintained, as Wolff did, that it is necessary to have some vital principle or force directing development. He called this the *spiritus rector* or *vis formativia*. But that, of course, is only giving a name to something of which we are totally ignorant. Driesch got into exactly this morass with his extreme epigenesis. The embryo had to come out of this undifferentiated material. How was it to be done? He imported an immaterial entity which he admits he got from Aristotle, the "entelechy." It cannot be studied in the laboratory, it is not subject to the laws of cause and effect, it is beyond the reach of experiment and observation. It is an influence of some sort that guides development.

Whitman took this defect of extreme epigenesis up in his lecture on evolution and epigenesis and he particularly paid attention to Bourne of Oxford, who had made fun of people who believed in the organization of the egg and likened them to the old pre-formationists. Whitman showed that there is some truth in both of these old ideas. We recognize now that embryology is a process of increasing differentiation under the influence of environmental stimuli and internal organization. The egg is an organism, it undergoes differentiation or development in response to environmental stimuli. If you please, this is evolution, the evolving from what is already inside a germ, but it is also epigenesis. So that genesis from within and genesis from without, endogenesis and epigenesis, are both true to a certain extent. That was the contribution of Whitman to this subject, well worth reading today and reading very carefully.

V. *Embryology is Biology in Miniature.*

A single generation's progress in such a subject as embryology cannot be very great, for after all, embryology is biology in miniature and all the problems of biology center in the egg and its development. For that reason it is one of the most important of all subjects. Professor Bert G. Wilder used to insist that even children in school ought to be given a course on the human brain. I am almost as much of an extreme advocate of embryology. It is the center and circumference of biology. A single generation's progress in the study of such a theme as this is of course almost infinitesimal. We have not begun to scratch the surface of the great problems to be solved. Some of my students say, "You people who went ahead of us cleaned it all up." On the contrary, we have just begun to open up the subject and the greatest problems are still to be solved.

One of the greatest of all problems of biology and embryology lies in the fact that development and evolution have worked toward specific ends, as it seems. There is a teleological principle in the process. Dr. Lillie lectured here in the early days on "Adaptations in Cleavage." He showed that a particular type of cleavage is adapted to a particular type of body that develops from it. There are still more marvelous instances. Take, for example, the development of the eye of a mammal which develops perfectly, ready for use, in the absence of light, the stimulus for which it is ultimately fitted. The end seems to have been in view from the beginning. Of course there are a variety of attempts to explain this. I have tried it recently in an article entitled "What Shapes Our Ends?" I am a mechanist; I believe that causal phenomena lie back of everything in the universe, teleology included. These are great problems and one of the best methods of studying them is found in embryology. Certain ends are attained in the course of development and the study of their causes can best be taken up in experimental embryology.

Truth is not usually found in extremes but in some *via media,* some comprise between extremes. Life itself is a compromise between organism and environment, between anabolism and catabolism, between heredity and development, between endogenesis and epigenesis. Truth itself is such a compromise and our science is neither absolute nor complete. It is an approximation to the truth. We get a little nearer but we never get to complete truth. We ought not, therefore, any of us, to "puff ourselves up," like the man who is supposed to have said, "I think the thoughts of God after him," when he had made some little discovery. Such enthusiasm helps a little, but after all it is just as well to remember that all science is but an approximation to the truth. We learn by trial and error and, eventually, by trial and success and "Truth sooner comes out of error than out of confusion." All science is flying from confusion, or, as Shapley, the Harvard astronomer, expresses it, "Flights from chaos." First of all, everything seems to be chaos and then, gradually, we find order, system, law. This is true of embryology as well as of everything else—flights from chaos to cosmos, from confusion to order.

(This article is based on a lecture given before the Embryology Class at the Marine Biological Laboratory on July 28, 1937).

THE 1937 MEETING OF THE CORPORATION OF THE MARINE BIOLOGICAL LABORATORY

(Continued from page 153)

Grave presented his own resignation. President Lillie, however, ruled that the Corporation should choose by ballot eight trustees from the nine candidates. Those receiving the largest number of votes were:

W. R. Amberson
W. C. Curtis
H. B. Goodrich
I. F. Lewis
R. S. Lillie
A. C. Redfield
C. C. Speidel
D. H. Tennent

The newly elected members of the Corporation are: H. B. Baker, G. W. Beadle, P. S. Crowell, Jr., Ernst Fischer, K. C. Fisher, Viktor Hamburger, M. J. Kopac, I. M. Korr, M. E. Krahl, J. A. Miller, C. L. Parmenter, R. W. Root, L. H. Schmidt, W. P. Spencer, L. E. TeWinkel, Abby Turner, C. L. Yntema.

Dr. Pond, the technical manager, mentioned some of the improvements which have been made in the equipment of the Laboratory. The new x-ray machine, operating at 200 kv. can produce 7500 roentgens per minute. The older machine has been rebuilt and is useful when lower voltages are required. Investigators who make pH determinations are able to work in a room which is kept at a constant humidity. Dr. Pond spoke in appreciation of the work of Dr. Richards, head of the chemical room, who resigns this year. The corporation voted to extend to Dr. Richards its thanks for his valuable services.

The director, Dr. Jacobs, reported the gift of the bathing beach property and bath house from Dr. E. B. Meigs; the gift of the land now occupied by the Penzance Garage and the adjoining lot to the east, from Mr. C. R. Crane; and the gift, also from Mr. Crane, of the sundial.

The rapid growth of the Laboratory is already proving to be embarrassing. This year the number of investigators is greater than ever before;

to accomodate so many, all available space has been used. Living accomodations in the village are also inadequate. Whether the Laboratory should expand or remain at about the present size is a serious question which the trustees will consider.

The Library also has grown far more rapidly than was anticipated when the present stack room was built. At present, 1339 serials are received annually and upwards of 3000 reprints. Mrs. Montgomery, the librarian, states in her report that within four years more shelf room must be provided. This is another question which the trustee committee will consider.

The corporation is thus faced with the necessity of finding a new director and of determining how it can solve the difficult problems caused by the rapid growth of the Laboratory.

THE PRESENT STATUS OF THE THYMUS PROBLEM

Dr. F. Gudernatsch

Visiting Professor of Biology, Washington Square College, New York University

In spite of much research in the field, the exact function of the thymus is still little understood, if at all. The organ is commonly considered with the glands of internal secretion. It has several features which might justify such a classification, at least to some extent. The thymus arises from the mucosa of some of the gill-slits, i.e., from a region where several other glands of internal secretion originate (thyroid, parathyroids and, not very far from it, the glandular hypophysis). It is, thus, an epithelial organ during the early period of its existence. Its mode of development is that of a gland, sometimes even the rudiments of a duct being recognizable.

Another reason why the thymus is grouped with the endocrine organs is that it is most prominent during the early very important period of life and that later it remains prominent in conditions in which there are other endocrine disturbances. In individuals in whom we observe clinical manifestations of under-development, we usually find an enlarged or a so-called "persistent" thymus.

Still there is nothing in the final morphology of this organ which justifies us in terming it a gland. It has no epithelial parenchyma to which a secretory function could be ascribed. There are no epithelial alveoli, tubules, acini, goblet cells. There are not even any cuboidal epithelial cells. Reticular cells, as such, cannot be considered to be "glandular." Neither are there any ducts (external secretion) nor vascular sinuses (internal secretion). Nor is there proximity between organized epithelium and endothelium. Even if the thymus were a gland its large size would speak against its being an endocrine gland. The typical endocrine organs are bodies of comparatively small size, their secretions such powerful agents that little tissue is required for their adequate production.

That, physiologically, the thymus does not have the importance of true internal secretion can easily be demonstrated by removing the thymus from the organism where upon no specific post-operative effects result. This has been demonstrated on many forms: by Hammar (1905) in frogs, Paton and Goodall (1904) in guinea pigs, Pappenheimer (1914) in rats, Marine and Manly (1917) in rabbits, Park and McClure (1919) in dogs, Anderson (1930) in rats and by others. Hypothymization, then, produces no endocrine disturbances. Still, during the earlier era of thymus experimentation and even later, many observers reported definite deleterious effects from thymectomy. All these, however, can be prevented by proper nursing of the operated animals. When they do occur they must be ascribed to secondary operative disturbances. There is general agreement on this point, although recently reports have again appeared in the literature (Rowntree and collaborators) indicating that, when successive generations of rats are submitted to thymectomy, there occur gradually increasing disturbances in the development of these animals. It remains to be seen to what extent the post-operative effects produced in successive generations are due solely to the removal of thymus tissue.

It is only the experiments in the other direction, namely hyperthymization, which thus far have given us some insight into the possible functioning of this organ. Early experiments of this type consisted in feeding to young animals thymus tissue or fractions derived therefrom. Later there came implantations and, finally, injection experiments.

In the early experiments of Gudernatsch (1910-) it was shown that frog tadpoles when fed exclusively on fresh thymus tissue would grow at a faster rate than the controls while at the same time their differentiation was much delayed. Many sets of the animals so treated never reached the stage of metamorphosis and actually became neotenic. The experiments were repeated by numerous investigators, confirmed by some, contradicted by others. While there was general agreement as to the growth-stimulating effect, the delay of differentiation was sometimes attributed to accessory conditions. On the basis of their own observations, it was concluded by some experimenters (Uhlenhuth, Swingle) that thymus tissue served merely as an optimal food for rapid growth. Still it could not be explained why a food so well suited for growth should be insufficient for differentiation.

This difficulty of explanation was early recognized. Gudernatsch had assumed two positive factors, one making for growth, the other suppressing differentiation. Romeis agreed with the first, but assumed the lack of some necessary factor as being responsible for the second—delay of differentiation. There is a possibility that this factor was iodine, since these experiments were performed in a region (alpine) where the iodine content of the water and soil is low. Still, similar experiments in other regions (lowlands) had given the same results.

To gain control over the possible influence of the food factor, Gudernatsch (1915) started experiments in which the animals were maintained on a complete diet and treated with a number of derivatives (7) which had been obtained by fractionation from fresh thymus tissue. The experiments showed that protein fractions, notably, the nucleoproteins and globulins, produced accelerated growth and at the same time there resulted proportionate differentiation. In the latter respect, these experiments differed from the early feeding experiments. Romeis, by another method, also obtained seven fractions, two of which delayed differentiation and one considerably stimulated growth. Abderhalden by still another method (enzyme digestion) obtained three protein fractions all of which stimulated growth.

During the years 1912-19, Gudernatsch also raised sixteen successive generations of rats which after the nursing period were given fresh or dessicated thymus in addition to ordinary food. As the experiment progressed, it became evident that the growth rate of the treated animals increased, though the results were not uniform throughout the entire stock. There was also improvement in the vitality of the stock, numerous pregnancies and large litters occurring. Seldom was a litter lost. The earliest recorded impregnation occurred on the sixty-ninth day, that is about ten to twelve days earlier than in the controls.

The initial stock had not been homogeneous. No definite conclusions were drawn from this experiment, though no such progressive improvement was seen in the controls. In 1930, the author stated that "at least one other large rat colony of known ancestry should be bred for several years under similar conditions so as to exclude the chance factor."

While the growth of thymus-treated rats was better than that of the controls it did not equal that of the pituitary-treated generations. In these, the earliest impregnation occurred on the 63rd day. (The pituitary effects were later shown very strikingly by Evans, Smith and Long, in injection experiments).

Table I

A few top weight figures in the control and thymus groups may be given for comparison (Roman figures indicate the generation):

Males	Control	Thymus
4 days	9 Grams	14 Grams (XII)
22 "	22 "	34 " (XI)
51 "	69 "	95 " (XI)
80 "		185 " (XII)
141 "	182 "	
Females		
4 days	8 Grams	10 Grams (XII)
8 "	12 "	17 " (IX)
17 "	18 "	27 " (V)
35 "		69 " (V)
42 "	59 "	
48 "		80 " (XI)
64 "		148 " (X)
84 "	125 "	

In 1929, Leon Asher in Berne and his students started a series of new hyperthymization experiments in rats. Feeding and implantation (previously also by Demel) of fresh thymus tissue produced very definite growth effects, even in rats which were kept under poor experimental conditions (qualitatively and quantitatively insufficient diets, absence of light). After the initial experiments, these workers prepared an extract from fresh thymus tissue by a method of fractionation which somewhat resembles the earlier Romeis method. On daily injection of this extract, called "Thymocrescin," the somatic growth curves became steeper than in the controls and, in addition, there appeared a striking acceleration of gonadal development. These results occurred in the first generation.

Attempts to purify this thymus extract further finally resulted in a Thymocrescin more than 40% stronger than the first extract. Experimental results became still better.

The accelerated gonadal development is a new observation in thymus physiology. From the earlier experiments and from clinical observations one would have expected a retardation rather than an acceleration. Thymocrescin contains protein fractions (peptides and amino acids) as shown by the biuret and ninhydrin reactions. The test for sulfur is very definite. The presence of sulfur in thymus tissue is also a new discovery. Another important feature of these experiments is the fact that under such stimulation no pathological disturbances arose. One usually observes such disturbances when one or another phase of development is being accelerated excessively.

In 1933, Rowntree and his collaborators in Philadelphia started a series of hyperthymization experiments in which successive generations of rats are being injected with an acid extract of thymus originally prepared by Hanson. From generation to generation, the growth curves of these animals become progressively steeper so that species size is reached earlier. There is no growth beyond the species size. At the same time, there occurs an intensive acceleration of somatic development. The effects are clearly noticeable in the third generation. More recent observations indicate that signs of acceleration are visible even in the first generation. Incisor teeth, for instance, have erupted at birth in later generations instead of at an age of eight to ten days. In the higher generations, pregnancies have occurred as early as the twenty-fifth day. The original four rats used for this experiment were Wistar Institute rats. Rats of this colony are of exceptionally high vitality and some pregnancies have been reported to occur before the fourtieth day.

Again in these experiments both phases of development, growth and differentiation, are being excessively stimulated without any pathological results occurring. Why the effects of the injections should become progressively greater in later generations cannot be explained at present. Naturally there is no hereditary transmission involved, in fact, the thymus effect is immediately dissipated when the animals of even the higher generations are not submitted to injection. There is a possibility that by injecting the mother, the embryo is conditioned to respond more readily to its own injections.

The Hanson thymus extract, too, represents protein fractions. Its sulfur content calculated as glutathione is very high, nearly 16%.

Since 1929, Gudernatsch and Hoffman have carried on extensive experiments* in which tadpoles are being treated with amino acids, singly or in combinations. The acids represent the only nitrogen food given to these animals, the basal diet being non-nitrogenous.

The experiments showed that a group of amino acids, the di-amino six-carbon acids, including the sulfur acids cystine and cysteine, proved particularly favorable for the growth of these animals. Other groups of simpler aliphatic acids were more favorable for general maintenance and still another group of aromatic acids seemed more favorable for differentiation.

In the course of these experiments the mixture of glutamic acid plus cysteine plus glycine was also tested. These are the component acids of glutathione. A mixture of the three proved definitely favorable for maintenance and growth of the animals. The observation is in line with the results obtained with the Hanson thymus extract and the Asher thymus extract and recalls the effectiveness of the thymus protein fractions observed by earlier investigators. In more recent experiments, the Rowntree group observed a marked growth-stimulating effect of glutathione by itself and of mixtures of glutathione with ascorbic acid.

The physiology of the thymus still remains unknown. As Hoskins and Hoskins stated in 1920 "It is one thing to bring about certain reactions by the use of preparations (extracted from glands with sulfuric acid, ether, acetone, alcohol, etc.) and quite another to prove that similar reactions are normally brought about by the living gland within the animal's body."

Neither cystine nor cysteine nor glutathione nor ascorbic acid are specific constituents of thymus tissue. They are found in other tissues as well and in some in much larger amounts. We have no explanation why they should be so highly effective when present in the thymus and extracted from it. There is, perhaps, the possibility that the thymus combines these constituents into some specific compound (compare iodothyreoglobulin) of hormonal potency. If so, what is the morphological substrate doing this chemical work? If so, what is the mechanism by which the manufactured compound is released into the circulation? And if it is a compound of hormonal importance, why then, when we deprive the animal of its thymus, does nothing demonstrable happen to the physiology of the organism?

(This article is based on a lecture delivered at the Marine Biological Laboratory on August 5).

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SOME ASPECTS OF NORMAL AND REGULATIVE DEVELOPMENT IN THE COLONIAL CILIATE, "ZOOTHAMNIUM ALTERNANS"

DR. F. M. SUMMERS

Assistant Professor of Biology, Bard College, Columbia University

A remarkable number of studies on metazoan "Organizers" have already demonstrated the importance of extrinsic factors for determination in specific parts. It was felt that additional information about these factors could be gained by applying operative techniques to an animal type in which, presumably, the relationships of parts have not attained so great a degree of complexity.

Zoothamnium alternans is a protozoan colony whose cells collectively possess in some degree many of the attributes of an individual organism. It is admirably adapted to this type of work for many reasons, particularly by virtue of the precision with which the characteristic colonial pattern develops.

One of the most important consequences of this study of more than 200 normal and operated colonies is the demonstration of qualitatively different physiological relations between cells at different locations on the colonial framework. Under normal conditions a specific pattern unfolds. When the cell at the apex of the frond-like colony is cut away some cell of a lower order, one whose complete developmental potentialities are never otherwise expressed, assumes the dominant generative functions and the normal colonial pattern perseveres in the parts regenerated by it. These results are intelligible in terms of what Child (1929) calls physiological correlations: the relation of dominance and subordination between parts. Apical control appears to be continuous and quantitative.

In this organism the transformation of the apical cell into an exconjugant initiates a developmental phase which furnishes another clue to the general nature of apical control. About four days after the union of gamonts, even before ex-conjugant generations are produced, the normal developmental relations are upset in an unusual way. The first three or four branches below the conjugant level begin to develop out of all proportion to the normal expectations. Each branch develops almost as an individual colony. Its cells divide precociously, forming secondary and even tertiary branch strains. The greatest effect obtains on the branch nearest the conjugant and diminishes basally as a gradient; the basal branches are apparently unaffected.

Under varying physiological conditions in the apical cell the coordinating influences exerted upon the mitotic activity of neighboring cells may be inhibitory (as shown by the regulative response after the apical cell is removed) or excitatory (when the apical cell is transformed into an ex-conjugant). The precocious development does not occur when the apical cell is present *or* when it is dissected away; it appears to be effected by some new quality in the coordinating mechanism arising in consequence of conjugation activities in one particular cell—the apical cell. These results invite the conclusion that the integrative factors in a colony of Zoothamnium are qualitative and discontinuous.

(This article is based on a seminar report given at the Marine Biological Laboratory on August 10).

MORPHOLOGY, BEHAVIOR AND REPRODUCTION IN TYPE A AND TYPE B OF "CHAOS CHAOS" LINNAEUS, THE GIANT MULTI-NUCLEATE AMEBA OF ROESEL

Dr. A. A. Schaeffer

Chairman of the Department of Biology, Temple University

This ameba I am about to speak of is not a new species. It is in fact the first ameba to have been seen. It was discovered by Roesel von Rosenhof, a painter of miniatures and an amateur naturalist, in 1755, in Germany. It has been seen only five times since 1755: in 1900 by H. V. Wilson in North Carolina; in 1902 by Penard in Switzerland; in 1916 by Kepner in Virginia and by Schaeffer in Tennessee, and in 1936 by Schaeffer in New Jersey.

It is curious to note therefore that the first ameba ever to be discovered is also the largest and apparently the rarest.

Because of its unusual characteristics and its importance as an experimental animal, the first thing to do after its rediscovery in September 1936, was to learn its habits and get it into permanent culture. This has now been accomplished, although it took many months to do it. On three occasions the cultures died down to 1 or 2 individuals because of parasites, deleterious bacterial or mold flora, etc. The culturing of this organism is now sufficiently well understood that permanent cultures can be confidently predicted.

The name of this organism is *Chaos chaos* Linnaeus, 1767. Since the discoverer of this ameba was a painter of miniatures by profession, one would expect that he would make accurate sketches of the ameba. And now that the living ameba is before us, we can see how keen was the power of observation of Roesel and how faithfully he sketched a number of the most important charactertistics of the ameba. A comparison of the characteristics of the living organism with the sketches and description of Roesel's can leave no reasonable doubt that the ameba from New Jersey and Roesel's description refer to one and the same species.

The principal morphological characteristics of *Chaos chaos* are very similar to those of *Chaos diffluens,* the common laboratory ameba, as for example, the ectoplasmic ridges and grooves; the shape, size and proportionate number of crystals; the number and specific character of the pseudopods; the shape and structure of the nucleus; its feeding habits, etc. The morphological characters of the two species, *chaos* and *diffluens* are, in fact, so nearly identical that it seems the one must be regarded as a multinucleate stage of the other.

The chief differences between the two species are: 1, *chaos* is multinucleate, containing up to 1000 nuclei (exact counts have not yet been made); cytoplasmic division in *chaos* results in 2, 3, 4, 5, or 6 daughters, 3 daughters being the usual number. 2, *chaos* is much larger, ranging in size from 300 microns to 1100 microns in spherical diameter and from 2 or 3 mm. to 9 mm. in locomotion. Reproduction is rapid. In one culture, under good conditions, one ameba produced 376 in 18 days; pieces of any size cut from an ameba grow up to normal size. Pieces with only one nucleus also grow up to normal size, with the normal number of nuclei.

All the nuclei divide mitotically at the same time. Division is accompanied by the assumption of a raspberry-like shape of the body, which may be attached to the substratum or roll around freely on it. Nuclear division must of course sometimes occur without cytoplasmic division. The different mitotic stages (now being investigated by Miss Hinchey) can be determined with a fair degree of accuracy by the appearance of the external shape of the raspberry-like reproductive stage.

Chaos chaos is not a single morphological entity or species, but consists of at least two varieties which may be called provisionally type A and type B.

Type A has biscuit shaped or discoid nuclei and in its division stages it usually rolls around on the substratum or is only very loosely attached to it.

Type B has broadly ellipsoidal nuclei, of smaller diameter and correspondingly larger number than type A.

In order to test the degree of antigenic relationship between *diffluens* and type A and type B of *chaos*, anti-sera were prepared (with collaboration of Dr. J. A. Harrison) by injecting cultures of these three varieties of amebas into rabbits. Only preliminary results have been obtained so far, and these indicate that these 3 amebas are closely related antigenically and that type B stands closer to *diffluens* than to type A.

During the course of the serological work it was discovered that this ameba has a distinctive odor. When 0.1 cc. of either type of *chaos* are crushed, prior to injection, a strong odor resembling that of ripe cucumbers is given off. Within a few seconds the cucumber odor changes to a fish odor. The odor is so strong that a single ameba, when crushed on a slide, gives off an easily detectable cucumber odor. *Chaos diffluens* posseses the same odor, but it is much weaker than in *C. chaos*.

Now a word about the correct scientific name of the common laboratory ameba, *Chaos diffluens*. The rediscovery of *Chaos chaos* and the fact that *C. diffluens* and *C. chaos* agree so closely in their morphological characters, places them unquestionably within one and the same genus. The name *Amoeba proteus* therefore becomes completely invalidated according to the rules. If, however, further work should show that *chaos* can be transformed into *diffluens* or the other way around, then all these varieties in question will have to be considered as a single taxonomic species and *diffluens*, 1786, will have to be dropped and *chaos*, 1767, used for all the varieties collectively. Varietal names, such as *diffluens, discoides, ellipsoides*, could then of course be used in addition to the species name *Chaos chaos*. All this depends however on what future research will bring out. For the present, the name *Chaos chaos*, Type A; *C. chaos* Type B, and *Chaos diffluens* are the correct designations according to the International Rules.

(This article is based on a seminar report given at the Marine Biological Laboratory on August 10).

CORTICAL CHANGES IN THE SEGMENTING EGG

Dr. Robert Chambers

Professor of Biology, Washington Square College, New York University

The protoplasm of the Arbacia egg possesses a cortex of an appreciable stiff consistency which becomes more pronounced after fertilization. It is into this cortex that the pigment granules eventually accumulate and is not to be confused with the so-called hyaline plasma layer or ectoplasm which is a condensation product of the fertilized egg and the removal of which is no detriment to the continued life of the egg. While the egg is still spherical the cortex is of uniform thickness and, by contracting to a certain degree exerts pressure on the interior. When the two telophase nucleii approach the periphery of the egg a softening of the cortex occurs at these regions, while the contraction of the rest of the cortex carries cortical material toward the equator which presses into the egg to form the cleavage furrow.

Evidence for these phenomena have been obtained by the microdissection of eggs which have been denuded of their fertilization membranes by mechanical means, and of the hyaline plasma layer by immersion in a KCl solution isotonic with sea water.

(This article is based upon a seminar report presented at the Marine Biological Laboratory on July 16, 1936).

CHROMOSOME STRUCTURE

Dr. B. R. Nebel
Associate in Research, N. Y. State Agricultural Experiment Station
and M. L. Ruttle

The structural history of the chromosomes of four plant species, *Tradescantia reflexa, Trillium erectum, Secale cereale,* and *Hordeum sativum* was studied in mitosis and meiosis. Meiosis in the orthopteran *Dissosteira carolina* was compared with these forms and found essentially identical. Most of the evidence collected came from permanent smear preparations.

Thread Number: Except at second metaphase, a chromosome is always eight-partite at metaphase and four-partite during the rest of the mitotic cycle. At second meiotic metaphase, however, the usual split is omitted and the chromosome of the second meiotic anaphase again contains four threads which, however, were present already at the first meiotic metaphase. This is shown diagrammatically in Figs. 1 and 2.

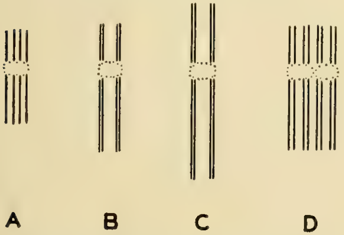

Figure 1. Diagram of mitosis. A, telophase with threads equidistant. B, interphase. C, prophase. D, metaphase. Multiplication of threads becomes visible during metaphase as soon as the prospective chromosomes of anaphase are ready to separate. Coiling has been disregarded; also the threads are not actually arranged in a single plane.

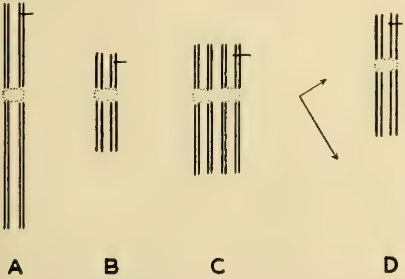

Figure 2. Diagram of one of the two chromosomes constituting a tetrad. A, leptotene. B, diakinesis. C, first meiotic metaphase and interkinesis. D, second meiotic anaphase showing one chromosome only. (The cross-bar is explained in the text).

According to this scheme, the tetrad prior to metaphase contains 8 threads arranged in pairs of 4 chromatids; the dyad likewise contains 8 threads, 4 in each half, each two of which form the new chromatids which originate at the metaphase of the first meiotic division.

There are key stages at which the half-chromatids are more easily observed than at others. These are *the early* telophases of all divisions. Studies of other forms should start from these.

The four-partitedness may be temporarily obscured during leptotene as the chromosome is then longitudinally distended and transversely reduced in size, and in the early anaphases through a slight delay with which the metaphasic multiplication becomes visible.

Terminology: A chromatid is a longitudinal half-chromosome. Chromatids can be observed at all stages of mitosis and meiosis. The dyad of all stages between the first and the second meiotic metaphase consists of two normal chromosomes, held together at the kinetochores (insertion regions). Hence the dyad contains four chromatids in two pairs of two. The term chromonema is avoided since it may apply to any filamentous chromatic structure within wide limits of dimension.

Half-chromatids are the last optically discernible chromatic threads in the present material, consisting at nearly all stages of two fine and closely paired threads, each pair forming a chromatid.

Coiling: In each form investigated, the width and pitch of the chromonematic gyres is specifically distinct for that species, but the changes of coiling in the different forms through successive stages follow the same general cycle. In Tradescantia, the somatic metaphase coil may be called the standard. This, during late interphase and early prophase, is lost through a process which gradually widens and then straightens the gyres of the standard coil. (Darlington has called the standard coil in this condition the "relic" coil.) While the standard coil of the previous divisions widens and straightens, the threads are thrown into a new standard coil which is at first fine and superimposed on the disappearing standard coil ("relic" coil), but gradually acquires standard dimensions. During premeiosis the standard coil of the last premeiotic metaphase is lost after interphase as in the somatic division. A new standard coil arises after leptotene. In Tradescantia it attains standard dimensions in diplotene and relic dimensions during the first meiotic division. It

(Continued on page 168)

The Collecting Net

A weekly publication devoted to the scientific work at marine biological laboratories

Edited by Ware Cattell with the assistance of Anna-Betty Clark, A. S. Cattell, Garnette McClure and Boris Gorokhoff.

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THE CHILDREN'S SCHOOL OF SCIENCE

The annual exhibition of the Children's School of Science and Junior Laboratory last week was an impressive one. The accomplishments of the pupils, whose ages ranged from six to sixteen years, was a credit to their instructors and to the officers of the school.

In 1915 Mrs. Charles R. Crane, Mrs. Frank R. Lillie and Mrs. James P. Warbasse lent to the Children's School of Science equal sums amounting to $1000.00, to be used without interest as a sinking fund for the life of the school. Part of this amount has been returned and the balance donated to the school. The contributions of the school to the character and education of so many children during the past twenty-two years must be a source of considerable satisfaction to these original sponsors.

Workers at the Woods Hole Laboratories know all too little about this unique enterprise. That is true even though the four officers are wives of members of the Corporation of the Marine Biological Laboratory; the school might be regarded as an embryo-in-law of the M. B. L. It would be of very great interest to make a study of the academic records of pupils who graduated twenty years ago to see whether a greater proportion of them have registered at the M. B. L. than from similar groups of children who did not attend the science school.

Financial limitations cramp the work of the school to some extent. The executive committee this year is suggesting that there may be people in Woods Hole who would be willing to loan microscopes for a few weeks. They would be used only under competent supervision and the instructors have given assurance that a microscope spending six weeks in the school house would suffer no more than would ones at the laboratory. We trust that these comments may come to the attention of several interested individuals who will make this unusual contribution to the institution.

Introducing

ERNST SCHARRER, comparative neurology, assistant in the Neurological Institute, Frankfurt am Main and fellow of the Rockefeller Foundation for Medical Research under Professor C. Judson Herrick in comparative neurology at the University of Chicago.

A native of Munich, Dr. Scharrer worked at the University there under the physiologist, Dr. Von Frisch, receiving the degree of doctor of philosophy in 1927. Later work under Professor Spielmeyer earned for him the doctorate of medicine in 1933 from the Research Institute of Psychiatry of Munich. Since that time he has been associated with the Neurological Institute.

He came first to this country in 1929 when he worked at the Osborn Zoological Laboratory of Yale University with Dr. Ross G. Harrison. He returned in March of this year to begin work under the Rockefeller fellowship at Chicago, which he will resume after leaving Woods Hole. In 1938, he and Mrs. Scharrer will return to Germany by way of Japan. Here he will spend some time in adding to his material for the histological study of the brain.

TO THE EDITOR:

REGRET EXCEEDINGLY UNABLE ACCEPT KIND INVITATION SPEAK AT YOUR BANQUET LABORATORY AND SUMMER COLONY PEOPLE TOGETHER WITH SECRETARY ICKES STOP NECESSARY FOR ME ATTEND AMERICAN FISHERIES SOCIETY MEETING MEXICO CITY THEN PROCEED WORK ON WEST COAST FROM THERE

FRANK T. BELL COMMISSIONER
U S BUREAU OF FISHERIES

CURRENTS IN THE HOLE

At the following hours (Daylight Saving Time) the current in the Hole turns to run from Buzzards Bay to Vineyard Sound:

Date	A. M.	P. M.
August 15	11:41	
August 16	12:23	12:38
August 17	1:19	1:26
August 18	2:11	2:19
August 19	2:58	3:05
August 20	3:42	3:49
August 21	4:24	4:35

In each case the current changes approximately six hours later and runs from the Sound to the Bay.

ITEMS OF INTEREST

Dr. W. A. Dreyer an investigator at the Marine Biological Laboratory during the past few summers has been promoted from instructor to assistant professor of zoology at the University of Cincinnati.

Dr. D. C. Smith, instructor of physiology at the University of Tennessee, has been appointed associate professor of physiology at the University of Maryland.

Dr. F. M. Summers has been promoted from instructor and tutor to assistant professor and fellow of biology at Bard College, Columbia University.

Dr. and Mrs. Allen B. Scott, the former assistant professor of biology at Union College, and chief of staff at the Children's School of Science, sailed on the *Europa* on August 10 for a six weeks' trip to England, Germany and France.

Dr. Rudolf Bennitt, who recently advanced to a full professorship at the University of Missouri, will head the program of Wildlife studies now in process of development at Missouri in conjunction with the newly established State Conservation Commission and other external assistance.

Dr. B. J. Luyet, professor of biology at St. Louis University, who is now at the Marine Biological Laboratory, delivered a paper at the Academy of Sciences in Paris on April 19 on the lethal effect of high pressures on yeast cells.

Dr. G. W. Beadle left during the past week to assume his duties as professor of genetics at Stanford University.

Dr. E. M. East, professor of genetics at Harvard University, arrived in Woods Hole on August 12; he is staying at the Breakwater Hotel for several days.

Dr. Louise H. Gregory, professor of zoology and assistant dean of Barnard College, arrived in Woods Hole on August 15 for a stay of several weeks.

The Commonwealth Women's Symphony orchestra played on August 4 for The Collecting Net Scholarship Association. A small but intent group of listeners applauded enthusiastically after almost every number. Since something over one hundred dollars had to be turned over to the Works Progress Administration to cover their expenses, The Collecting Net suffered a considerable immediate financial loss.

Dr. Franz Schrader, head of the department of zoology at Columbia University, and Dr. Sally Hughes-Schrader, professor of zoology at Sarah Lawrence College, arrived in Woods Hole on August 9 for the meeting of the Board of Trustees and members of the Corporation. After a week's stay they will return to New York City.

Dr. and Mrs. V. A. Pertzoff, research professor of physical chemistry, of the Institut de Chemie, Montpellier, France, left Woods Hole on August 9 after visiting Dr. and Mrs. Paul S. Galtsoff. Dr. Pertzoff visited this country to acquaint himself with recent American contributions to the field of physical chemistry.

Dr. Cecil von Bondt, government marine biologist and director of fisheries, Union of South Africa, visited Dr. Galtsoff at the Bureau of Fisheries at Woods Hole on August 6. Of particular interest to him were the lobster hatching experiments of Dr. E. W. Barnes, as he is studying the reproductive and developmental processes of the craw fish. Dr. von Brondt had already visited the Bureau of Fishery Stations at Washington, Chicago, Halifax, and Boston. Before his return to Cape Town at the end of September, he will have been in New York, England, Scotland and Germany. His especial interest is the practical side of fishery work and he has gathered much data for correlation in Cape Town.

A son, David Albert, was born to Dr. and Mrs. James A. Miller on August 6. Dr. Miller is instructor of zoology at Ohio University.

Five recent additions to the animal room of the Marine Biological Laboratory comprise two woodchucks, one goat, one sheep and one skunk.

ADDITIONAL INVESTIGATORS

Conley, C. L. fel. phys. Maryland Med. Br 225. K 9.
Duggar, B. M. prof. plant phys. Wisconsin. Br 222. D 316.
Grand, C. G. res. assoc. biol. New York. Br 320. McLeish, Millfield.
Hoffman, Olive instr. med. Pennsylvania Med. Br 123. Fish, Main.
Holmes, J. H. fel. phys. Maryland Med. Br 225. K 9.
Martin, W. E. instr. biol. Purdue. Br 126b. Shaffner, Millfield.
Malick, Leona F. grad. asst. zool. Brown. Br 342. H 6.
Mitchell, P. H. head dept. zool. Brown. Br 342. Cassidy, Millfield.
Painter, Elizabeth E. instr. phys. Maryland Med. Br 225. Millfield.
Smith, D. C. instr. phys. Tennessee. Br 109. A 107.
Uhrich, J. fel. zool. Chicago. OM 36. Lillie, Gardiner.
Walford, L. A. U.S.B.F. 123. F 44.

DEPARTMENT OF PUBLICATIONS

CULTURE METHODS FOR INVERTEBRATE ANIMALS. A compendium prepared cooperatively by American zoologists under the direction of a committee from Section F of the American Association for Advancement of Science. Paul S. Galtsoff, Frank E. Lutz, Paul S. Welch, James G. Needham, Chairman. Comstock Publishing Company, Inc., Ithaca, N. Y. 1937.

It is quite impossible for any one person to make a critical appraisal of the varied contributions of this valuable compendium. Within the limits of the reviewers acquaintance of certain fields the writers are well selected and include eminent authorities in those fields. The articles, for the most part, are concise and practical and the illustrations are line cuts which are simple and clear. The following tabulation of the distribution of topics may be of interest.

Protozoa	53	Annelida	12
Porifera	1	Arthropoda (of which 161 are Insecta)	196
Coelenterata	5		
Platyhelminthes	11		
Nemertea	1	Mollusca	13
Nematoda	9	Echinodermata	6
Trochelminthes	2	Chordata	
Bryozoa	2	Ascidiacea	2

This table indicates clearly that we live in an "Age of Insects" and their importance is only approached by the Protozoa. No doubt the large number of contributions to these two groups does indicate their present importance in science, especially in applied biology. It may be hoped, however, that future editions will add to some of the less well represented phyla. The editing committee states that the book is "only a beginning." This is a welcome statement as any such compendium must continually be revised to make it as alive as the science it represents. This type of a record puts in accessible form much information which is often handed on only by word of mouth. The reviewer believed that this is an exceedingly valuable manual which will be of real help to a great variety of biologists, in high school and university and to teachers and to investigators.

—*H. B. Goodrich.*

CHROMOSOME STRUCTURE

(Continued from page 165)

is called the major coil of meiosis according to Huskins and Smith. This coil persists until interkinesis when it becomes straightened in the usual way. From diakinesis through interkinesis the prospective standard of the next cycle may be observed and is called the minor coil of meiosis (Huskins and Smith). The undulations of the latter may at first prometaphase be seen to run as three or four waves over each half gyre of the major coil.

RADIATION: As further evidence of the thread number, especially during presynaptic stages, hard and soft x-rays and aluminum filtered radiations of radium were used to dissect the chromosome at the critical stages. Since the chromosome of the second meiotic anaphase is identical with the chromatid of synapsis (except for a further internal split), radiation was applied to presynaptic stages and the effect was observed during the first as well as the second meiotic division, when it could be seen and recorded with relative ease.

If lesions are observed during the second meiotic anaphase which affect only two of the four threads at a given locus, this is considered as evidence of the fact that the chromosome was fourpartite before synapsis. This is shown by the cross bar inserted in the successive stages shown in Fig. 2. According to this, a lesion affecting one of the four threads in the premeiotic chromosome appears as a corresponding lesion in two threads of the first anaphase chromosome and as a lesion affecting only a single chromatid (two threads) in the second meiotic anaphase.

Lesions of this type were found and the evidence is considered confirmatory. An alternate explanation of these figures would make it necessary to assume that radiation might cause a delayed effect located in the unsplit chromatid or its environment which is held inactive until the splitting of the threads. Then this delayed effect would have to become active in such a way as to choose between the two resulting sister threads of the next multiplication and react with one and not with the other. Partial inactivation of the dividing mechanism is in this category. These alternatives are considered of small likelihood.

Half-chromatid lesions are distinct but statistically rare. Half-chromatids while physically visible are believed physiologically dependent, which is in agreement with the fact that, in legitimate crossing-over, chromatids and not half-chromatids are the units of reaction.

(This article is an introduction to a round table conference by the Genetics Society of America on "Progress in Cytogenetics" at the Marine Biological Laboratory on September 4, 1936).

NOTES AND NEWS FROM M. B. L. CLASSES

BOTANY CLASS NOTES

From regular class field trips the botany class has turned to voluntary collecting trips. Last Saturday afternoon Nonamesset saw two row boats, laden with eager collectors, approaching its shore. Although the rowing wasn't as good as that of a Harvard crew we arrived in good time.

Stimulated into action by the discovery of Scinai, an algae which has not appeared here in many years everyone scrambled out of the boats into the water, plunging eager hands at mysterious clumps on the sandy bottom. Although many specimens of other marine forms were found only two or three little pieces of the precious Scinai were found. Dr. Taylor had presented us with the names of specimens to be mounted by the students for the show case. Those who found their special assignments were more than pleased with the day's outing.

Heterokontae, Chrysophyceae and Euglenophyceae were our problems under Dr. Drouet last week. Dr. Prescott has now presented us with Charales, Bacillariophyceae and Dirophyceae for laboratory work. The oh's and ah's of excitement show that many of these forms have flagella. But the true spirit of the lab can only be felt when you listen to 95% of the class humming snatches of songs to the little motile forms. Maybe a serenade helps to charm them from their wandering over the slide and causes them to stop and listen for a while. What ever it is the "Botanists" are still smiling into their microscopes. —*J. P. H.*

INVERTEBRATE CLASS NOTES

An active and, we are told, typical first week has just passed for more than half a hundred "pea-green freshmen." For like our predecessors we have been faithful to all that Woods Hole offers—lectures, laboratory, the mess, beach parties, swimming and, as we have been adequately warned by all instructors, night-before cramming for reports due at 9 A. M.

The Coelenterata and our unmentionable Ctenophora (what a canal system!) have for four days been focused upon, poked at and teased by needles and pipettes filled alternatively with carmine and clam-flavored sawdust.

Lectures by Dr. Crowell have included not only taxonomy, but also interesting summaries of the experimental investigations on these phyla and valuable hints for further individual research. With an interruption for collecting at Rocky Beach and joy of all joys,—a whole day trip to Kettle Cove, we feel exceptionally well treated by the staff and have learned to smile at envious outsiders through the discomfort of our over-pink complexions.

With only a day's respite, however, we are again experiencing the vicissitudes of life around the Marine Biological Laboratory for we are rushed home from the cold breakers of Kettle Cove only to be dashed into hot water by comparing our drawings with those excellent two-handed board sketches of our new morning lecturer, Dr. Hadley. —*S. W.*

PENZANCE PLAYERS

The date of the Penzance Players' 1937 summer production of Edward Massey's comedy "Plots and Playwrights" has been set for Wednesday and Thursday, August 18 and 19, in Community Hall, Woods Hole. This play represents the results of the young players' summer dramatic efforts and is to be given this year for the benefit of the Woods Hole Public Library.

Mrs. Girdiner Handy of Falmouth and the Woods Hole library who directed the melodrama "Gold in the Hills" in the summer of 1934 is directing the play which is otherwise acted and produced by the players themselves.

The cast to date includes Thomas G. Ratcliffe as Caspar Gay, a successful Broadway Playwright; Frederick Copeland as Joseph Hastings, a youthful short story writer; Miss Peggy Clark as Maggie, an Irish servant; Miss Bobbie Johnstone as motherly Mrs. Hammond; Miss Mary Draper as her vaudeville actress daughter, Molly Hammond; Allen Clowes as Frank Devoy, the vaudeville actor; Miss Persis Crowell as Alice Merriam, an art student; Miss Anne Janney as the Play-girl stenographer, Bessie Dodge; Miss Betty Copeland as Edme Jackes, the ingenue; Dr. Raymond Cable as the down-at-heels professor, William Lloyd; Wister Janney in the part of Dick Griffiths, the studious Juvenile with Ideals; Parry Kraatz as Dick's mean brother, Sidney Griffiths; and Reed Estabrook as the comedy friend, Bob Douglas. The Production Committee includes Manton Copeland, Jr. as business manager, Miss Betty Patten in charge of properties, Miss Cynthia Cahoon as wardrobe mistress, and Miss Peggy Clark as technical director.

The tickets at $1.00, .75 and .50 will go on sale Wednesday, August 11, at the M. B. L. Office, at the Woods Hole Library, through the Library's Patronesses, and through the Business Manager of the Penzance Players, Manton Copeland, Jr.

EXTRA-CURRICULAR ACTIVITIES

M. B. L. CLUB NOTES

At a meeting of the executive committee on Monday, July 26, the discussion centered on the financial affairs of the club. Bids were received and accepted for replacing the obsolete and worn-out lavatory equipment, for keeping the lawn in order and setting a rose hedge on the west side of the club-house, for replacing the worn-out window cords in all windows of the club and repairing the window slides, for complete refinishing of the floors upstairs and down and for repainting the trim. These items, plus the estimated expense of operating the club for the balance of the season, very neatly used up the surplus funds of the Club, leaving nothing for several other recommended expenditures. This obviously calls for additional revenue and it is the hope of the committee that a series of musicals, lectures and entertainments may be arranged to aid in retiring the indebtedness incurred in re-roofing the building.

Two benefits are planned in the future for the M. B. L. Club. On Wednesday, August 25, a bridge and tea will be held at the Clubhouse with a 50c admission charge. The next evening, Ralph M. Pearson, an art authority, will be presented in the Community Hall at 8:00. His lecture is entitled "Modern Art and its Meaning to the Community." Tickets are $1.00 and may be secured in advance.

TENNIS TOURNAMENT NEWS

Before one of the largest galleries of the season, the team of Mrs. Edward A. Norman and Mr. Arthur Frew beat Miss Virginia Mayo and Dr. Theodore Ruebush 6-3, 6-1 to gain the finals of the M. B. L. Tennis Club Turnament. Previously the Norman-Frew duo beat the Root-Stunkard combination 8-6, 6-2, then Rugh and Rugh 6-3, 6-2.

The finals of the men's doubles tournament of the M. B. L. Tennis Club are to be played on Saturday at 2:00 P. M. In one bracket of the semifinals, the Ruebush-Patten team plays the Harrold-Schoenborn duo on Friday at 2:00. The winner of this match meets the winner of the Cox-Miller vs. Kidder-Summers contest (semifinals in the other bracket) in the final contest.

The unusually dry weather has prompted the fire department to issue a warning that no fires at all should be built by anyone in the woods. If properly taken care of, fires may be built on beaches, although permits must be obtained from the local fire house. A series of wood fires elsewhere on the Cape this past week has made this warning very timely.

THE CHORAL CLUB CONCERT

The eleventh annual concert of the Woods Hole Choral Club will be presented on Monday evening, August 23, in the Woods Hole Community Hall. The Club is holding extra rehearsals in order to get its program of eleven numbers into shape. Tickets will be fifty and twenty-five cents, available from members of the Choral Club and at the door.

The program, consisting of songs varying from humorous folk tunes to devout anthems, is as follows: "The Gypsy," Zolatarieff; "Cherubim Song," Musicheskoo; "Hear My Prayer," Arkhangelsky; "The Brook," Arkhangelsky; "The Old Woman and the Pedlar," "Matthew, Mark, Luke and John," "Ca' the Yowes," and "Peggy Ramsay," all folk songs; "Cantato Domino," Hassler; "One Smiling Summer Morning," Italian, and "From the Realm of Souls Departed," Gluck. —*B. I. G.*

CHILDREN'S SCHOOL OF SCIENCE

The Children's School of Science and Junior Laboratory held its annual exhibition and party on Friday afternoon, August 6. A large crowd of visitors examined with interest the collections of insects and plants and other exhibits which have been prepared by the children this summer. Dr. Cowdry and others served ice cream to a large "never ending" line of children.

At the annual meeting of the Association, held the same afternoon, the following officers were elected: Mrs. E. V. Cowdry, president; Mrs. James Mavor, vice-president; Mrs. Robert P. Bigelow, treasurer; Mrs. Alfred Redfield, secretary.

At a meeting of the Woods Hole Yacht Club last Sunday evening, Dr. H. C. Bradley, professor of physiological chemistry at the University of Wisconsin and member of the staff for physiological investigation at the Laboratory, was elected *commodore*. Other officers chosen were G. G. Whitney, *vice-commodore*; Dr. Edward B. Meigs, physiologist of the U. S. Department of Agriculture, *rear-commodore*; Edward A. Norman, *secretary*; Dr. E. R. Clark, professor of anatomy at the University of Pennsylvania, *treasurer*.

Finsler's comet, visible during the past few days in the northern sky, was observed from sidewalk, street and golf course by the people of Woods Hole. Although hidden by clouds on the night of its greatest brilliance, the comet and larger tail were clearly distinguishable to the naked eye on neighboring evenings. One group whose celestial attention wandered to the south on Tuesday evening saw two of the moons of Jupiter with the aid of an 8-power binocular.

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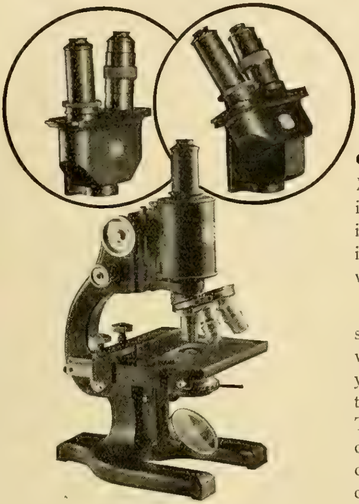

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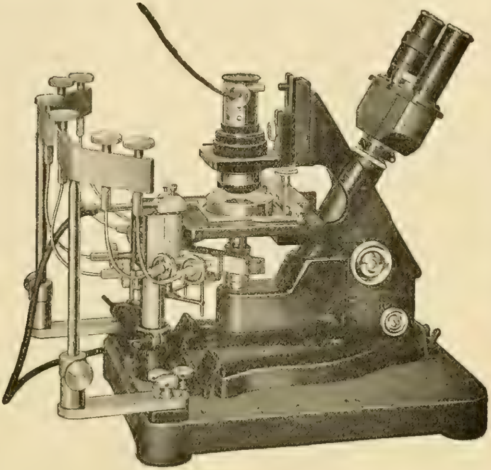

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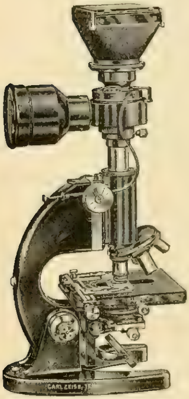

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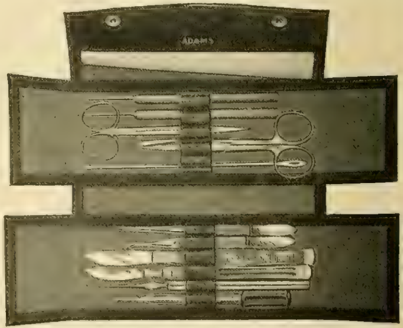

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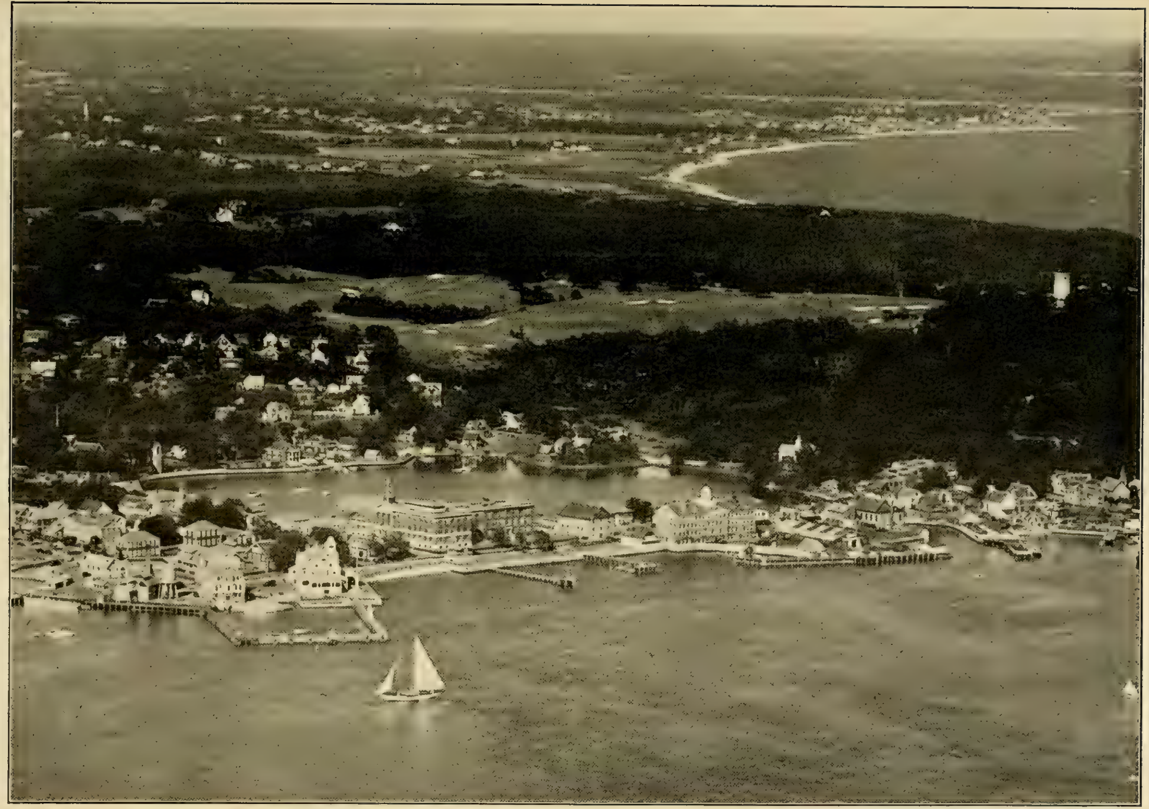

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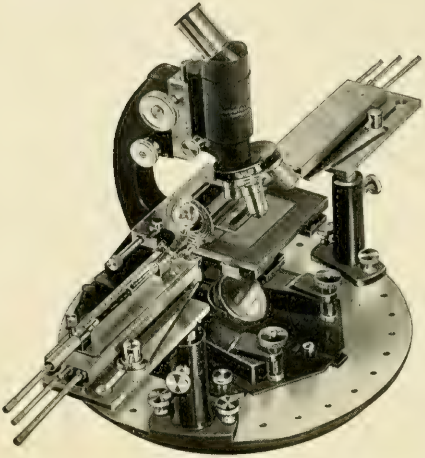

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THE COLLECTING NET

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SOME PHYSICAL ASPECTS OF MUSCULAR CONTRACTION

Dr. Ernst Fischer

Associate Professor of Physiology and Pharmacology, Medical College of Virginia

The problem of volume change during muscle contraction seemed to be settled at the middle of the last century. All textbooks of physiology contained at least until 1925 the statement that there is no change in volume during muscular contraction. In that year Ernst and later on Meyerhof and co-workers reinvestigated this question and observed reversible diminution of volume during isometric contraction of about 1/1000% of the muscle volume.

The muscle volumeter used in my own investigations is very similar to that of Ernst or Meyerhof and consisted of a tightly closed glass chamber; the only opening was a small capillary. The dimension chosen made the volumeter a little more sensitive than those of the earlier investigators, allowing the recording of even the change by a single twitch in one frog sartorius. The capillary is filled with hexane to prevent capillary friction as much as possible. By means

(*Continued on page* 185)

M. B. L. Calendar

TUESDAY, August 24, 8:00 P. M.

Seminar: Dr. B. Luyet: "Cellular Death by Freezing."

Dr. D. Mazia: "Binding and Penetration of Bivalent Cations in Elodea Cells."

Dr. G. H. A. Clowes, A. K. Keltch, and Dr. M. E. Krahl: "Factors Governing Cellular Responses to Nitro and Halo Phenols."

Dr. M. E. Krahl, Dr. G. H. A. Clowes, and A. K. Keltch: "Role of Acidic Dissociation in the Physiological Effects Produced by Nitro and Halo Phenols."

Dr. Rudolf Höber and Dr. Bernard Nebel: "Depolarization of Muscle and Nerve Membranes by Organic Substances."

THURSDAY and FRIDAY, August 26 - 27

General Scientific Meetings.

METAMORPHOSIS IN ASCIDIANS

Dr. Caswell Grave*

Rebstock Professor of Zoology, Washington University

The phenomenon of metamorphosis is exhibited by all species of animals in which the individual organism begins its life in an environment different from that in which it lives as an adult.

The type of metamorphosis that occurs in the ontogeny of ascidians involves transformations the most abrupt and complete of any known. Here an actively swimming chordate larva gives place within a period of about 15 minutes to an inert creature attached to, and adapted for a sedentary life on the bottom.

The structural and physiological requirements of the two modes of life are so different that two independent action systems develop side by side from the zygote, one to function as a free-swimming larva, the other as the fixed ascidian. The larva that hatches from the egg therefore has the structural characteristics of a dual organism and it exhibits the antagonisms to be expected of two individuals contending for dominance. Both organisms de-

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THE COLLECTING NET TRIP TO PENIKESE

Top Row: The Captain's wife comes aboard (Dr. Snider and Miss McClure in the foreground); 62 ready to go; *Life* goes to a party (Mr. and Mrs. Goro, *Life* photographers, in the foreground). **Second Row:** Dr. and Mrs. Lucas have a good time; Dr. Michaelis and Dr. Mavor do, too; Boris Gorokhoff and Jean Shumway (auditors of the trip). **Third Row:** A young lady pulls Hiatt's hair. **Fourth Row:** *The Winifred* mixer; Mr. Moore and Miss Huntington; The Captain's wife wiles away the hours.

(Photographs taken with a Zeiss Ikon Super Ikomat).

velop together for a time at the same rate but a stage is soon reached when the larva gains the ascendency and inhibits all further growth and differentiation of the ascidiozooid. When larval life has run its course disruption of the larval action system takes place and simultaneously the adult action system is released from larval inhibition and resumes its rapid growth and differentiation. The events that occur in the lives of this dual organism at the critical stage when larval life ends and the life of the adult form begins, constitute metamorphosis. This lecture has for its purpose a report of the progress that has been made in ascertaining what these events are and what constitute the mechanism of metamorphosis, in larvae of the species, *Polyandrocarpa tincta* and *Phallusia nigra,* the former having a free-swimming period of about 12 to 15 hours, the latter of about two days.

The first method of experimental treatment to be developed by which metamorphosis is greatly accelerated involves the exposure of groups of larvae of Polyandrocarpa in shell vials of 10 cc. capacity to a series of periodic changes in light intensity. Fifty to sixty such changes, made by covering and uncovering a vial containing larvae with an opaque tumbler, at intervals of 1 minute, usually induced an epidemic of metamorphosis, none taking place in the untreated control vials for several hours. It was at first believed the effective part of this treatment consisted in some specific effect of light but when it was found that the same result follows treatment of larvae with mechanical jarrings at similar, one minute intervals, it became clear that any treatment that causes larvae to swim vigorously at frequent intervals, will induce an epidemic of metamorphosis. Broods of these larvae were frequently liberated however, that could not be induced to metamorphose by exposure for an hour to 60 light intensity changes or mechanical jarrings, some requiring 90, some 120, some 180. One lot was treated at intervals throughout an entire day without the induction of a single case of metamorphosis although all larvae had been made to swim vigorously at each stimulation. No amount of larval swimming activity would cause these larvae to metamorphose until they had undergone a process of aging as a result of which some substance is probably secreted with which the metabolic by-product of swimming activity must react to cause metamorphosis. The time required for this aging substance to appear and thus render the larvae *susceptible* to the effect of larval activity, varies with different broods of larvae.

Since no amount of aging without activity will bring about an epidemic of metamorphosis and since no amount of activity without the aging or susceptibility factor can cause metamorphosis, it is evident that the accelerating agent is a third substance formed by a reaction between the "susceptibility" substance and the byproduct of neuromuscular metabolism.

In a search to find the identity of the chemical substances that constitute the mechanism of ascidian metamorphosis, many substances known to be byproducts of metabolism were added to sea water and used as experimental media.

Groups of larvae segregated in shell vials of 10 cc. capacity were treated with sea water media containing lactic acid, acetylcholine, oxygen, CO_2, 15 amino acids, adrenalin, pituitrin, thyroid gland extract, anterior lobe extract and to changes in pH following the addition of KOH, NaOH and HCl.

The effect of one of these substances only need be described since the series of later experiments by which the accelerating substance has been tentatively identified was suggested by the high percentage of metamorphosis induced by a sea water extract of dessicated mammalian whole thyroid gland. It was assumed at the time that the effective agent in this extract is the hormone, thyroxin, and therefore that the endostyle of ascidians, the homologue of the thyroid in Vertebrates, probably produces the thyroxin essential to metamorphosis of ascidian larvae.

Several endostyles were carefully dissected from the pharyngeal tissues of adult Phallusia, weighed, and ground with sea-water. The filtered extract, used in making media of several concentrations, was even more effective in inducing metamorphosis in groups of Phallusia larvae than thyroid gland extract. These striking results seemed to confirm the assumption that the accelerator of metamorphosis in ascidians is thyroxin but, when it was later found that sea water extracts of vertebrate glands other than thyroid; (pituitary whole gland and anterior lobe) and that other tissues of Phallusia (mantle, atrium or pharynx) all contain something that is effective in inducing 100% metamorphosis in groups of larvae after treatment for very short periods, (none occurring in the controls), the thyroxin hypothesis became untenable and search was begun to find what the extracts contain that accelerates metamorphosis.

Work with sea-water, and fresh water tissue extracts of both species of ascidian soon revealed the fact of species specificity in the accelerating substance, an extract of Phallusia tissue that induces 100% metamorphosis in Phallusia larvae, not being effective in the induction of metamorphosis in larvae of Polyandrocarpa and vice versa; an extract of the tissues of Polyandrocarpa that induces 100% metamorphosis in groups of Polyandrocarpa larvae within less than an hour

* Dr. Paul A. Nicoll has collaborated in the latter part of this investigation concerned with ascidian tissue extracts and substances extracted from, or assumed to be present in these extracts.

of exposure to the medium, is not effective, even after several hours, in inducing a significant percentage of metamorphosis in larvae of Phallusia.

Fresh water extracts of Phallusia tissue were treated with substances known to precipitate proteins; 2% sulphosalicylic acid and 1% phosphomolybdic acid. The precipitate was removed and the filtrate brought to the pH of sea-water. None of the potency of the tissue extract is lost by the removal of the protein fractions. The protein free filtrate induced metamorphosis as effectively and quickly as the whole extract.

Phallusia fresh water extracts were then treated with various lipoid solvents; absolute alcohol, acetone, benzene and chloroform. In each case the filtrate was evaporated, the residue taken up in sea-water and used as a medium for treatment of Phallusia larvae. The undissolved material on the filter paper was in each case also ground and extracted with sea-water the filtrate being used as experimental media. The results in all cases showed that the lipoid fraction lacks the accelerating substance and that an extract of the residue is nearly as effective in inducing metamorphosis as the whole extract.

Phallusia extracts were subjected to heat (drying at room temperature, drying at 180°C and refluxing for several hours) without impairing the potency of the accelerating substance but when the tissues were charred no accelerating substance could be extracted.

These results pointed to some relatively simple salt as the accelerating substance. Such an assumption received further support from the fact that this substance dialyzes through a collodion membrane.

Recourse was now had to a purely randon selection of salts likely to be present in ascidian and vertebrate tissue extracts.

Sea water media made with salts of various heavy metals proved to be so effective in the induction of metamorphosis in groups of larvae of both species that further work was confined to search for the metal salt that induces metamorphosis the most quickly and normally and at the same time is one present in the tissues of ascidians in an amount sufficient to account for the concentration required to catalyze the process of metamorphosis. While the chlorides and nitrates of aluminium, copper, iron and zinc are all effective in the induction of high percentages of metamorphosis when used in the proper concentrations in sea-water, $CuCl_2$, in a concentration of 2×10^{-6}, was found to be not only the most rapid in its accelerative action but to leave no toxic effect on the ascidiozooid, provided the experimental medium was replaced with sea water 3 minutes after the larvae were placed in it. In this concentration 100% metamorphosis was induced in Polyandrocarpa larvae in 9 minutes; 72% metamorphosis in Phallusia larvae in two hours. While $FeCl_3$, in a concentration of 2×10^{-4}, induces 100% metamorphosis in Phallusia larvae in two hours and is also effective with Polyandrocarpa, inducing 100% metamorphosis in 33 minutes, the amount of iron naturally present in the tissues of neither species in sufficient to account for the concentration required to induce metamorphosis.

Analysis of dessicated Phallusia and Polyandrocarpa tissues show that both contain copper in sufficient amount for the requirements of metamorphosis.

It seems difficult to account for the species specificity shown by the tissue extracts on the assumption that the accelerating substance is a simple copper salt, but we are doubtless dealing here with a complicated enzyme system and the specificity aspect of the mechanism of metamorphosis may well reside in some substance other than the metal salt.

It seems possible to harmonize many of the seemingly conflicting results of this investigation by assuming that many of the substances that have been found to induce a significant percentage of metamorphosis do so because of their content of iron or copper as impurities, for example; the whole gland preparations of vertebrate thyroid and pituitary and the amino acids; glycine, leucine and histidine may well contain such impurities.

Dr. Michaelis concluded his lecture a week ago with a reference to a future occasion when he may be able, after further investigation, to reveal the finished picture of the oxidative mechanisms of the organism, but he warned the audience of his fear that the dramatic moment of the unveiling may lose its thrill because only another veil may be revealed behind the one removed.

Search for the formula of the mechanism of metamorphosis of ascidians conforms to this general experience of biologists in their search for the order of Nature which was once well stated

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by Professor W. K. Brooks in a comment concerning the discomforture of the closed field of the old physics when the full implications of the discovery of the Roentgen Ray began to be realized. His comment was to the effect that "Physicists could have been warned by the experience of biologists when they were looking for more worlds to conquer, that every discovery in science instead of solving the problem in hand, uncovers ten new problems each requiring solution."

No end to this succession of veils within veils is in sight, hence ascidians should be encouraged to continue to produce an abundance of larvae, and Arbacia and Asterias, the inlimited production of eggs for they all will be needed to the Nth generation of biologists for their successive studies of metamorphosis, mitosis and other biological processes.

(This article is based on a lecture delivered at the Marine Biological Laboratory on July 30).

SOME PHYSICAL ASPECTS OF MUSCULAR CONTRACTION

(Continued from page 181)

of a microscope the movement of the meniscus is photographically recorded simultaneously with the isometric contraction curve. It is easy to discriminate between the transient changes during contraction and the changes thereafter. In those records, which were more or less identical with those of Ernst and Meyerhof, after the transient decrease in volume during contraction, the volume at the end of contraction is still somewhat smaller than the original volume, but now the volume steadily increases, finally crossing the starting position. Meyerhof and co-workers were able to demonstrate in vitro the volume changes of the encymatic reactions involved in muscular activity. They explain the negative difference in volume before and after contraction by the amount of phosphoric compounds broken down and the steady increase after the contraction by the formation of lactic acid. They do not express themselves very clearly concerning the transient volume changes during contraction, although it is obvious that they prefer to regard them as caused by chemical reactions involved in contraction.

In opposition to Meyerhof, Ernst believes that the volume constriction precedes markedly the mechanogram and he therefore relates the volume changes to the excitatory process. In support of his opinion he quotes the fact that the volume curve shows oscillations in the frequency of the stimulation even for frequencies above the minimum frequency needed to produce complete isotonic tetanus. In our own experiments the volume curves become smooth for a stimulation frequency a trifle higher than the frequency needed to produce a smooth tension curve. This was found not only for striated muscles of frog, eel and dogfish, but also for a smooth muscle, the retractor of Phascolosoma, a marine worm, belonging to the Sipunculidea. Ernst believes that in the work with frog muscles due to the high velocity of all processes involved, the recording of the volume changes is markedly delayed. Therefore I used strips of turtle hearts at a relatively low temperature. Although thus the contractile process is about 30 times slower than in a frog sartorius at room temperature, yet the same set-up recorded exactly the same parallelism between the volume change and the contraction. The volume decrease starts already during the latent period of the mechanogram and reaches its maximum a little earlier than the latter. Only in the later phase of relaxation the return of the volume decrease precedes to some larger extent the relaxation.

However, only under a certain condition did we succeed in getting records absolutely identical with those published by Meyerhof. We found that the resting length of the muscle used, has a very large influence upon the volume change during contraction, but not upon the volume changes thereafter. Only for low initial tension did we find the marked transient volume decrease. But if the muscles were stretched to higher extent, the volume curves changed their courses. They are no longer parallel to the mechanogram, but become polyphasic. With further increasing stretch, especially for the parallel fibred sartorius at high initial tension, a pure volume dilatation occurs more or less parallel to the tension curve. From our data it is evident that the more parallel the arrangement of the fibres is in a muscle, the more readily initial tension can reverse the volume decrease into an increase. Similar results were obtained with eel and dogfish muscle and also on smooth muscles, retractor and longitudinal strips of the body wall of Phascolosoma.

To assume that all these muscles have the same working metabolism and that this metabolism is governed qualitatively for all these muscles in exactly the same way by the initial tension is unlikely. It is much more likely that the volume changes are associated with the contractile mechanism itself. Considering the fact that muscle under high tension shows the smallest amount of internal movement during contraction, one may be inclined to assume two different factors governing the volume changes during contraction: 1) the change from the resting to the active state of a contractile element is accompanied by a volume increase. 2) shortening of contractile elements diminishes the volume.

Are there other changes observed in muscular contraction, which are affected in a similar way by the initial tension or which occur in a polyphasic manner as the volume changes at medium initial length? Muralt has published curves of the decrease in double refraction of frog sartorius during isometric twitches, which resemble very much the volume curves for this muscle at about the same initial tension. Concerning the influence of initial tension or length upon the change in birefringence during contraction no evidence could be found in the literature. All investigators report a marked decrease during isotonic contraction, while for isometric contractions every thing has been observed from a small decrease over no change at all to even a small increase. Since nearly all this work was done on frog muscle, it is suggestive to assume that the difference in results may be due to a difference in resting length employed by the various investigators.

Our own experiments with frog sartorius indicated indeed that for isometric contraction the loss in birefringence during contraction diminishes with increased resting length. However, the apparatus at our disposal, did not allow very careful study of this question on the sartorius. The retractor of Phascolosoma was a much better subject for our purpose; it can be stretched over a longer range, its contraction is much slower and the muscle is of much more uniform diameter. We found marked disappearance of double refraction for isotonic contraction and diminished double refraction for isometric contraction at low length. With increasing length the diminution during isometric contraction becomes smaller and smaller; finally no change occurs, or as observed in some muscles at very high initial length, even a small increase of double refraction.

By fixing muscles by formaldehyde, which does not alter the total double refraction, an analysis of the causes of birefringence was made on muscles at various lengths in medium contraction by the imbibition methods developed by Ambronn and W. J. Schmidt. For isometric contraction at medium length about 40% of total birefringence is "micellar birefringence" and 60% "form birefringence." The micellae themselves have a refractive index of 1.52 and the surrounding phase of 1.33. From these data the ratio between micellar volume and volume of the surrounding phase can be calculated according to the formula of O. Wiener. Furthermore one must conclude that the micellae are rod-shaped and of crystallite nature. The latter has been proved convincingly by the x-ray spectrograms of Astbury and others.

In isotonic contraction the marked decrease in total double refraction is due to a nearly complete loss in "form birefringence," while the "micellar birefringence" is merely halved. This can be only explained by assuming that the originally rod shaped micellae become more or less spherical during isotonic contraction, that their parallel arrangement is not disturbed and that the crystalite structure of the micellae has been diminished but not abolished by a folding of the molecules inside the micella. Such a supercontraction of the myosin molecules has been established by the investigation of Astbury.

In an isometric contraction at high initial length the total double refraction during isometric contraction is higher than at a lower length. This is due to a marked increase in "micellar birefringence" and was to be expected according to Astbury's researches. "Form birefringence" is a little diminished and this may be explained in the following way since no disarrangement of the the micellae can be supposed. According to O. Wiener's theory such a diminished "form birefringence" may be due to a decrease in the ratio between the volume of the micellae and the surrounding phase. Such a change in this ratio could be caused by the fact that in the stretched state a micellae can include less water molecules than at a lower length. Bound water requires less space than free water. In consequence, when a shift of water from the micellae to the surrounding phase occurs, the total volume should increase. Such an increase has been found for stretching resting muscle by Meyerhof. Thus we may also explain, why, when a stimulated muscle is allowed to shorten, the volume decreases.

But from our volume experiments it was evident that when shortening is prevented, not only no volume decrease occurs but even an increase. This increase can be explained according to K. H. Meyer's theory of the supercontraction of myosin molecules, a theory which is in full agreement with the recent findings of Astbury. In solutions, acid or basic in regard to the isoelectric point of myosin, either the free amino or carboxyl groups are ionised, charged positively or negatively and the ionised group is surrounded by a solvate layer. If the pH of the solvent is suddenly changed to the isoelectric point, both the amino and the carboxyl groups become ionized with opposite charges; thus an attraction results and a formation of a "zwitterion" without a solvate layer. The destruction of the solvate layer causes a setting free of bound water, thus increasing the volume as long as the micellae do not shorten.

One can develop a scheme for the submicroscopical changes during muscular contraction under various conditions and calculate the approximate dimensions of a micella and their changes by uniting all information gained by volume and birefringence measurements with those by other investigators concerning x-ray pattern, length and weight of the myosin molecule, maximal size of particles still penetrating inter or intra micellar, etc.

Such a proposed scheme may still be far away from the conditions realized in nature, but it offers at least a foundation for further research.

(This article is based upon an evening lecture presented at the Marine Biological Laboratory on August 6).

OBSERVATIONS AND EXPERIMENTS ON SEX CHANGE IN THE ADULT AMERICAN OYSTER, "OSTREA VIRGINICA"

DR. PAUL S. GALTSOFF
Biologist, U. S. Bureau of Fisheries

The work was undertaken with the view of obtaining sufficient evidence of the sex changes in the adult *Ostrea virginica.* Methods used by previous investigators consisting in comparing sex ratios of oyster populations or by examining a small piece of gonad tissue of the living mollusks obtained through a hole bored in the shell, are open to criticism. The first method is obviously inadequate in case of sex changes in both directions; the second is objectionable on account of the unknown effect of injury on the presumably unstable gonad of the mollusk. The method used in this investigation consisted in determining the sex of the oyster by inducing ovulation or ejaculation by increased temperature and chemical stimulation (Galtsoff, 1930, *Proc. Nat. Acad. Sci., 16,* No. 9, pp. 555-559). Of each of the 203 adult oysters tested at Woods Hole during the summer of 1936 an individual record of the spawning reaction was obtained and the discharged products were examined under a microscope. Each oyster was then measured and marked by engraving a number on its right shell. Elaborate precautions were taken to avoid any possibility of mismarking. Oysters were then transferred to Milford, Connecticut, where they were kept in large tidal tanks. The same procedure was repeated with the marked oysters during this summer. The results are summarized in the following tables.

Oysters in which shedding of eggs or sperm was induced in 1936

	Total	Died	Missing	Survived
Males	132	6	1	125
Females	70	9		61
Discarded	1			
	203	15	1	186

The same oysters in 1937

	Unchanged	Sex Reversed	Failed to React	Percent Sex Reversed	Total No. Sexually Active
Males	113	♂ — ♀ 10	2	8.0	121
Females	53	♀ — ♂ 8		13.1	63
Total	166	18	2	9.7	184

One can notice from the above table that 9.7% of the oysters have reversed their sex. The percentage of reversals was considerably higher among females (13.1%) than among the males (8.0%). The mortality during the year was only 7.04% which is probably a normal death rate of adult oysters. The percentage of failures to react, due to lack of gonad development was only 1.07 indicating healthy conditions under which the organisms were kept. The preponderance of males used in the experiment was not due to the abnormal sex ratio but to the fact the ejaculation in the males is more easily induced than ovulation in the females. So far no hermaphrodites were found among the sex reversed oysters, each of them discharging either sperm or eggs. These oysters were not however dissected but are being kept for further experiments.

The physiological characteristics of the female and male sex reactions were subject to previous study by the author (Galtsoff, 1930, 1932, 1935*). Ovulation of the female is accompanied by typical rhythmical contractions of the adductor muscle and passage of eggs through the gills, while in the male ejaculation proceeds through the cloaca and does not involve specific behavior of the adductor. In the sex reversed males the physiological set-up of the organism changes with the change of sex and typical female reaction develops. In several instances, however, the development of this reaction lagged, the newly formed female still acting as a male by discharging eggs through the cloaca and failing to develop rhythmical contractions of the adductor. Its kymograph record could easily have been mistaken for a male reaction. A month later a typical female reaction was fully established. Another sex reversed male had fully developed muscular reaction but the discharge of eggs continued through the cloaca indicating the deficiency in the mechanism forcing eggs through the gills. All sex reversed females reacted as true males. From these observations a conclusion is reached that female reaction has developed as a secondary adaptation which provides a mechanism for the dispersal of eggs throughout the water. The male reaction is regarded as a primary sex reaction of the oyster.

A hermaphroditic oyster found among a group of new oysters tested during this summer had an atypical reaction possessing the characteristics of both sexes. This oyster discharged eggs and sperm capable of self fertilization.

Present observations establishing a sex reversal which simultaneously occurs in both sexes indicate that Orton's theory of the change in the type of metabolism (from protein to carbohydrate) as a sex determining factor in *O. edulis* is not applicable to *O. virginica*. It appears more plausible to expect that the changes of a fundamentally bisexual gonad of *O. virginica* are controlled by some hormonic system in which the development of one sex or another is inhibited. Whether these changes are hereditary characters which occur only in a certain group of individuals remains to be demonstrated by further observations.

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* *The Collecting Net,* Vol. X, No. 9, pp. 261-264.

(This article is based on a seminar report given at the Marine Biological Laboratory on August 10).

CONCENTRATION AND PURIFACTION OF BACTERIOPHAGE

DR. JOHN H. NORTHROP
Member of the Rockefeller Institute, Princeton, N. J.

A method for isolating a nucleo protein from lysed staphylococci culture was described. This protein is very unstable and is denatured by acidity greater than pH 5.0, and by temperature over 50° C. for 5 minutes. It is digested by chymotrypsin but not by trypsin.

It is homogeneous in the ultra-centrifuge and has a sedimentation constant corresponding to a molecular weight of about 300,000,000. The diffusion coefficient varies from about 0.001 in solutions containing more than 0.1 mg. protein/ml. to 0.02 in solutions containing less than 0.001 mg. protein/ml. The rate of sedimentation also decreases as the concentration decreases. It is suggested, therefore, that this protein exists in various sized molecules of from 500,000 to 100,000,000 molecular weight, the portion of small molecules increasing as the concentration decreases.

The loss in activity by heat, acid, and chymotrypsin digestion is roughly proportional to the amount of denatured protein formed under these conditions. The rate of diffusion and the rate of sedimentation of the protein are the same as those of the active agent. The loss in activity when susceptible living or dead bacteria are added to a solution of the protein is proportional to the loss in protein from the solution. Non-susceptible bacteria remove neither protein nor activity.

The relative ultra-violet light absorption, as determined directly, agrees with that calculated from Gates' inactivation experiments in the range of 2500-3000 Å but is somewhat greater in the range of from 2000-2500 Å.

Solubility determinations showed that most of the preparations contained at least two proteins, one being probably the denatured form of the other. Two preparations were obtained, however, which had about twice the specific activity of the earlier ones and which gave a solubility curve approximating that of a pure substance.

It is suggested that the formation of phage may be more simply explained by analogy with the autocatalytic formation of pepsin and trypsin than by analogy with the far more complicated system of living organism.

(This article is based on an evening lecture given at the Marine Biological Laboratory on August 13).

A SEA WATER BUFFER FOR MARINE EGGS

DR. ALBERT TYLER
Instructor in Embryology
and N. H. HOROWITZ
Fellow in Embryology, California Institute of Technology

The dipeptide, glycylglycine, is found to serve as a suitable buffer to replace the bicarbonate system of sea water. It has the appropriate dissociation constant ($10^{-8.1}$) for buffering in the region of the pH of ordinary sea water and has a high solubility in sea water. It is, of course, also important for a buffer to be "physiologically inert" or at least to produce no injurious effects. An examination of the action of glycylglycine on eggs of Urechis, Strongylocentrotus and Arbacia, shows that completely normal development occurs in 0.05 molar solutions in sea-water (carbonate-free). Between 0.05 and 0.10 molar thick-walled blastulae and gastrulae are often formed. Above 0.10 molar, development is usually abnormal, although cleavage proceeds apparently normally in concentrations as high as 0.25 molar.

Thus, in many kinds of experiments in which the bicarbonate system is apt to cause difficulties because of such factors as the volatility of carbonic acid, physiological effects produced by it, and the slowness of attainment of equilibrium conditions, glycylglycine may be substituted. Phosphate is not suitable in sea water since above pH 6.3 it begins to precipitate out the Ca and the Mg. Egg albumen or gelatin, which would buffer over a wide pH range, block cleavage in low concentrations. Veronal which has about the same pK as glycylglycine causes abnormal development at 0.002 molar, although cleavage can occur in a 0.01 molar solution.

(This article is based on a seminar report given at the Marine Biological Laboratory on August 17).

GEMMIPARY IN KALANCHOE ROTUNDIFOLIA AS COMPARED WITH OTHER CRASSULACEAE

Mr. H. N. Stoudt

Instructor of Biology Temple University

The phenomenon of vegetative propagation in Crassulaceae has received much attention from students of morphology and physiology. A comparison of the morphological development of plantlets of this species with those of other Crassulaceae should aid in understanding more adequately the phenomenon so characteristic of the group.

Leaves of *Sedum Stahlii,* according to Yarbrough (1936) produce plantlets on the short petiole. Here, upon separation of the leaf from the plant, the apparently mature parenchyma cells of the petiole resume mitotic activity and organize a secondary meristem which in turn produces plantlets.

Stoudt (1934) demonstrated that a sessile leaf of *Byrnesia Weinbergii* produces a plantlet from a residual meristem at the base of the leaf. No organ rudiments are differentiated in this region of the normal mature leaf and differentiation occurs only after the leaf is removed from the plant, whereupon the dormancy of the meristem is broken and a plantlet develops.

The opposite leaves of *Kalanchoe rotundifolia* are three to four centimeters long and narrow at the basal end to form a petiole and a protuberance is frequently evident in this groove, close to the point of attachment of the petiole with the stem. This protuberance is a plantlet primordium consisting of two leaf primordia and a stem primordium. Development of these rudiments on the mature leaf then ceases until the leaf is separated from the parent plant. Root primordia appear only after the leaf is separated from the parent plant for sometime.

Freeland (1933) finds that the "foliar bud" on the mature leaf of *Bryophyllum crenatum* possesses a stem primordium and sometimes leaf primordia but no root primordia. The latter originate later and adventitiously on the stem of the plantlet beyond the parent leaf.

Naylor (1931) states that, in *Bryophyllum calycinum,* the primordia of the entire new plants are already present in the notches of the mature leaf.

Plantlets of *Kalanchoe daigremontiana,* according to Johnson (1934) and *K. tubiflora,* according to Clamp (1934) are produced on leaf-claws from a residual meristem between the teeth of the leaf. These plantlets are often differentiated into leaf, stem and root rudiments long before the parent leaf has attained its maximum size.

Thus in mature leaves of *Sedum Stahlii* the parenchyma tissue is de-differentiated to form a secondary meristem which, in turn, produces a plantlet. In *Byrnesia Weinbergii* a residual meristem is present which is undifferentiated into organ rudiments. In *Kalanchoe rotundifolia* leaf and stem primordia, only, are present whereas in *Bryophyllum crenatum* stem and sometimes leaf rudiments are found in the mature leaf. Roots arise later. In *Bryophyllum calycinum* root, stem and leaf primordia are formed that are usually externally invisible on the attached mature leaf. Finally, in *Kalanchoe daigremontiana* and *K. tubiflora* both leaves and roots are externally visible on a flattened axis while the leaf is still attached to the plant. All of these plants exhibit the same general phenomenon. Their greatest differences are in the stage of development attained by the meristem, or organ rudiments derived from it, when the leaf falls.

(This article is based on a seminar report given at the Marine Biological Laboratory on August 2).

OBSERVATIONS UPON THE CHEMICAL COMPOSITION AND THE METABOLISM OF A LARVAL PARASITIC NEMATODE

Dr. Theodor von Brand

Fellow in Helminthology, Johns Hopkins University, School of Hygiene

The experiments were performed with an immature Eustrongylides from *Fundulus heteroclitus.* The red colour of the worms is due to the presence of haemoglobin in the body fluid. With its low fat and high glycogen value the general chemical composition resembles that of the adult Ascaris. The worms consume per unit weight much less glycogen than Ascaris, if kept in saline at 37° C under aerobic conditions. They are able to keep their glycogen level high, even if their hosts starve for a long time and lose during this starvation period more than half of their polysaccharide stores.

(This article is based upon a seminar report presented at the Marine Biological Laboratory on August 10).

THE EFFECT OF CO_2 UPON THE OXYGEN CAPACITY OF THE BLOOD OF SOME FRESH-WATER FISH

Edgar C. Black
Demonstrator in Experimental Biology,
and Dr. Laurence Irving
Professor of Biology, University of Toronto

Conditions of respiration for fish differ from the respiratory conditions for mammals. The respiration of fresh-water fish must proceed in a medium in which the pressure of oxygen is always less and the pressure of carbon dioxide usually greater than in atmospheric air. At different levels in the water, pressures of gases are altered by changes in temperature and the respiratory function of the blood will also be altered by the temperature changes. Types of blood which are suitable for the transport of CO_2 and oxygen under one set of conditions might be quite unsuitable under another set. The characteristics of the blood of the carp (*Cyprinus carpio L.*) and the common sucker (*Catastomus commersonii*) show examples of two types of blood, each suited for a different and limited range of pressures of oxygen and CO_2.

Oxygen dissociation curves obtained for those two species are not of the sigmoid type which is characteristic of mammalian blood. The presence of 5 or more mm. Hg CO_2 (for the carp 10 or more) prevents the complete saturation of whole blood, even at high partial pressures of oxygen. This effect of CO_2 is quite different from the familiar effect of CO_2 upon mammalian blood. In the presence of relatively high pressures of CO_2 the blood of the carp is suitable for the transport of small quantities of oxygen, while the blood of the sucker would be quite useless. At very low pressures of CO_2 and high pressures of oxygen in the water the blood of the sucker can serve to transport much more oxygen than that of the carp. The blood of the sucker is suited for intense activity in well aerated water, while the blood of the carp is suited for survival in poorly aerated water where the sucker could not exist.

The striking effect of CO_2 upon certain types of fish blood is quite different from that upon mammalian blood. We noticed that acidity effected large changes in the volume of the red cells as the oxygen capacity diminished. Dr. Dill suggested that we should determine whether or not hemolysis influenced the CO_2 effect. Hemolysis by the addition of saponin to the blood of the sucker, carp and bowfin (*Amia calva*) abolished the effect of CO_2 upon the oxygen capacity at high pressures of oxygen (150 mm.). The CO_2 effect is in part at least dependent upon the integrity of the corpuscles.

(This article is based on a seminar report given at the Marine Biological Laboratory on August 17).

RESPIRATORY MECHANISMS IN THE FERTILIZED AND UNFERTILIZED SEA URCHIN EGG: A TEMPERATURE ANALYSIS

Dr. Irvin M. Korr
Instructor in Physiology, New York University College of Medicine

It was the purpose of this investigation to study (1) the temperature relations of different types of respiration, (2) the factors determining temperature coefficients of cellular respiration and (3) further to analyze the change in oxidative rate and mechanism that occurs in the egg of the sea urchin upon fertilization. The oxygen uptake of fertilized and unfertilized eggs, of eggs in the presence of KCN, pyocyanine and of combinations of KCN and pyocyanine, was measured at different temperatures from 11-28°C. Cyanide, which greatly diminishes the respiration of the fertilized egg, but is without effect on the respiration of the unfertilized egg, is known to act by combination with the iron in indophenol oxidase, thereby abolishing the catalysis of the oxidation of cytochrome. The respiration that remains after complete poisoning of this system is thought to proceed through an autoxidizable "hydrogen-carrier." Pyocyanine, a natural, non-ferrous respiratory pigment, is known to function as such a carrier by virtue of its reversible oxidation-reduction. It is alternately reduced by (accepts H atoms from) the substrate dehydrogenase systems and is reoxidized by (gives up H atoms to) molecular oxygen. As shown by Runnström, addition of this pigment to suspensions of fertilized, unfertilized and cyanide-poisoned fertilized eggs increases their respiration by increasing the rate of H-transfer between substrates and oxygen. The relation of this increased respiration to temperature therefore offers a convenient means of studying mechanisms.

The O_2-consumption/unit volume of egg/hour (Q_{O_2}) of the normal and variously treated eggs was plotted against temperature in eight series of experiments. From the curves thus obtained were calculated the temperature coefficients and the ratios of respiratory rates of the different eggs to each other.

It must not be forgotten that the temperature coefficients (which change with temperature range) of the unfertilized egg is much higher than that of the fertilized egg. (Cf. Rubenstein and Gerard, 1934). It was found in this work that the difference is such that at 13° the fertilized egg respires about 9.5 times as rapidly as the unfertilized egg, but would have the same respiration, by extrapolation, at 36°.

The respiration remaining after cyanide poisoning of the fertilized egg has a very low temperature coefficient, as compared with the untreated egg. That is, the relative effectiveness of KCN varies with temperature, so that at 28° two-thirds of the respiration is abolished, but only one-third at 12° (maximum inhibition).

The coefficients of fertilized eggs whose respiration has been as much as tripled by the addition of pyocyanine remains essentially unchanged. The same is true of KCN-fertilized eggs whose respiration has been restored to or above the original rate, with pyocyanine.

The situation is very different in the unfertilized egg, in which the temperature coefficient is an important function of the concentration of carrier (pyocyanine) and, therefore, of rate. For instance, 0.003% pyocyanine, which increases the respiration of the unfertilized egg 2.5 times at 28° (2.6 at 13°) hardly alters the temperature coefficient. A higher concentration, 0.009%, which increases the respiration 3 times at 28° (5.5 at 13°) lowers the coefficient to a figure intermediate between that of the fertilized and unfertilized egg. The highest concentration (0.015%) which the egg can withstand without rapid deleterious effects, not only lowers the coefficients to those of the fertilized egg, but also raises the respiratory rate, at all temperatures, to that of the fertilized (about 4 times the unfertilized, at 28°, 9.5 times at 13°). A number of different graphic analyses showed that, as far as rates and temperature coefficients (Q_{10} and μ-values) were concerned, the unfertilized egg had been converted into a fertilized egg.

These results, in conjunction with other observations for whose discussion there is not space in this preliminary report and with those of other workers on oxidative mechanisms in the sea urchin egg, show that (1) respiration through a simple autoxidizable carrier and respiration through the cytochrome-indophenol oxidase system do not, *per se,* have different temperature coefficients; that (2) the hydrogen-transfer mechanisms in the fertilized and unfertilized eggs are the rate-controlling links in the respiratory chain, since the substrate-dehydrogenase systems are capable of as rapid activity in the unfertilized as in the fertilized egg. (3) The temperature coefficients are largely determined by the ratio of the rate at which the labile hydrogen is transferred, from the substrates to oxygen, to the maximum rate at which labile hydrogen can be produced by the substrate-dehydrogenase systems. The more nearly the hydrogen-transfer rate approaches the maximum hydrogen-production rate, the lower is the temperature coefficient, and vice versa—within the limits set by the normal fertilized and unfertilized egg.

Further discussion of the respective mechanisms in the fertilized and unfertilized egg will be given in the full report.

(This article is based on a seminar report given at the Marine Biological Laboratory on August 17).

PLUTEI WITH NUCLEUS AND CYTOPLASM OF DIFFERING SPECIES

Dr. Sven Hörstadius

Associate Professor of Zoology, University of Stockholm

The nucleus-plasma problem is very old. The question is whether the heredity is controlled only by the nucleus or also by the cytoplasm. Some authors speak of a plasmon, or cytoplasmic genes, thus indicating that some characters are transferred by the cytoplasm in a constant way from generation to generation. As sometimes reciprocal crosses give maternal dominance, this would be due to the large cytoplasm of the egg, the nuclei being alike. Such cases are found among some insects (Habrobracon, Lymantria), and many plants, e.g. Epilobium. Especially interesting are the results on mosses (von Wettstein), where both hybrids and individuals with multiplied sets of chromosomes could be compared, and where a cytoplasmic influence was demonstrated for many generations. But some authors point out, that this does not necessarily mean a real inheritance, but only a relative change in the rate of some of the developmental processes.

Another way to approach this problem is to eliminate the cytoplasm of the one species, the nucleus of the other. This was first tried by Boveri (1889), when he fragmented sea-urchin eggs by shaking, and fertilized the fragments with sperms of another species. Some larvae thus obtained showed only paternal characters and were interpreted by Boveri as heterosperm merogones, that is to say larvae developed from an enucleated egg-fragment with a sperm nucleus from another species (*Sphaerechinus granularis* and *Psammechinus microtuberculatus*). This result was doubted by many investigators, who meant that hybrids often show only paternal characters, and that Boveri's larvae really were hybrids, not merogones. After careful studies, Boveri in 1918 admitted his mistake: his larvae must have been hybrids since heterosperm merogones of these two species do not develop further than to the gastrula stage. Later experiments on sea-urchins by other investigators did not lead to any results, the merogones dying before any species-characters developed. The same holds for experiments on Amphibians (Baltzer).

Heterosperm merogones of the combination *Paracentrotus lividus* nucleus + *Psammechinus microtuberculatus* cytoplasm, and vice versa, gave good larvae which were swimming about and feeding for three weeks. The merogones were obtained by cutting away a small fragment of the egg, including the nucleus, and fertilizing the large, enucleated fragment with strange sperm. One of the reasons why nucleus and cytoplasm do so well together in these two species may be that the chromosomes are practically alike, both regarding number and form, although the species belong to different genera, thus showing considerable anatomical differences.

The apical rods in the pluteus of Paracentrotus are straight and slender. In Psammechinus the ends of the apical rods are bent, thickened and irregular. Haploid individuals (homosperm merogones) show the same characters as the diploid ones. Hybrids give intermediate types. Larvae with Paracentrotus cytoplasm and Psammechinus nucleus may develop the typical Psammechinus characters: bent, thickened, irregular rods, the species character thus following the nucleus. But also the reciprocal combination shows some irregularities, but not so marked as in Psammechinus. The interpretation of these minor irregularities is difficult. They resemble the Psammechinus characters, as they appear less markedly than normal in hybrids and haploids. But also if these irregularities were due to the cytoplasm of the heterosperm merogone, this does not necessarily mean real inheritance. To prove that, several generations are required. The case may be that the irregularities are due to the action of the egg nucleus, or of the mother, already before fertilization. It has been found, that high temperature results in irregularities in the skeleton in sea-urchin larvae (von Ubisch, Nümann). The same holds for Paracentrotus. Also these irregularities resemble those in the larvae with Psammechinus cytoplasm and Paracentrotus nucleus. It is thus impossible to decide whether the irregularities in these merogones are due to a Psammechinus character, transferred through the cytoplasm, or, more likely, are to be regarded as a Paracentrotus character due to the nucleus, which character appears under unfavorable conditions, such as heat or a strange cytoplasm.

(This article is based upon a seminar report presented at the Marine Biological Laboratory on August 4, 1936).

METHODS FOR THE STUDY OF RAPID CHEMICAL REACTIONS AND THEIR APPLICATION TO THE KINETICS OF ENZYME-SUBSTRATE AND ENZYME-INHIBITOR COMPOUND FORMATION

Dr. Kurt G. Stern and Mr. Delafield DuBois

Laboratories of Physiological Chemistry and Physiology, Yale University Medical School

The observation of spectroscopically defined enzyme-substrate and enzyme-inhibitor compounds, made in the course of recent studies on catalase and peroxidase, offers an experimental approach to the detailed analysis of the mechanism of enzyme action. Optical methods are being developed to obtain quantitative information on the rate of formation and of breakdown of the labile enzyme-substrate compounds. In experiments of this type ferrihemoglobin (methemoglobin) may often be used as a non-enzymatic model catalyst.

A photoelectric method for the recording of such processes and some preliminary results have been reported here last year. Monochromatic light passes through the colored solution of the catalyst and falls on the cathode of a gas-filled photoelectric cell. At the beginning of the experiment the substrate is injected into the catalyst solution by means of a spring gun. The changes in light absorption in the course of the reaction between catalyst and substrate produce corresponding changes in the intensity of the photoelectric current which, after amplification, are recorded by means of a string galvanometer and a moving film camera.

The drawback of the arrangement comprising a single photocell is that not only color changes of the system under study but also changes in concentration or physical phenomena like foaming or formation of turbidity will cause variations in the photoelectric current. In order to eliminate these possible sources of error a differential photometer containing two vacuum photoelectric cells in a compensating circuit was developed. Here the beam of light is split up by a half-silvered mirror into two beams striking the cathodes of the two photocells. At the beginning of the experiment the two cells are balanced against each other so that no current flows in the amplifier circuit working on the "floating grid" principle. The color changes accompanying the chemical reaction under study throw the system out of balance. The resulting current flow in the radio tube is registered as before by the string galvanometer. This apparatus is quite insensitive against any other but color changes.

Though this modified arrangement presents certain advantages over the simpler apparatus, the records obtained by it are still subject to about the same kind of interpretation as is a shadow with regard to the actual shape of the object responsible for it. The present report deals with the results obtained by a simple spectrographic arrangement which permits the recording of fast reactions without the use of photoelectric or electric instruments. An absorption cell containing one reactant is placed between the light source and the slit of a spectrograph. The plate holder is removed and close contact is established with the entrance slit of a falling plate camera. While the plate is falling the second reactant is rapidly injected into the absorption cell. The time is indicated either by a rotating time marker, controlled by an electric tuning fork, or by a neon tube flash arrangement. The photographic plate registers a continuous series of spectra, corresponding to 350 individual spectra on one plate. The use of a supersensitive panchromatic plate permits rates of fall of more than 26 cm. per second. Each spectrum is photographed at this speed in less than 0.002 seconds. This apparatus records any changes in light absorption in the system due to the reaction of the components and correlates them with time. The rate of the fall of the photographic plate has been varied between 0.3 and 29 cm. per second. The plates may be further analysed with the aid of a microphotometer.

The results obtained so far with this method may be summarised as follows: In control experiments where methylene blue was injected into water a mixing time of 0.008 to 0.027 seconds was found. In the course of other experiments transition times even shorter than these, 0.0065 seconds for completion and 0.0019 seconds for half completion, were observed.

The dissociation of human oxyhemoglobin at pH 8.6 and 28.5° was found to be complete after approximately 0.08 to 0.12 seconds. This value is of the same order as that extrapolated from G. A. Millikan's measurements with the flow method of Hartridge and Roughton.

The rate of combination of ferrihemoglobin with hydrogen peroxide, ethyl hydrogen peroxide, hydrocyanic acid and hydrofluoric acid was studied at pH 5.3 and 26-27°C. The results demonstrate the dependence of the rate of reaction upon the ratio and concentration of the reactants, as would be expected from a bimolecular process. This may be illustrated by the fact that, with a ratio of ferrihemoglobin to hydrogen peroxide of 1/160, oxygen as the product of the over-all reaction is released appreciably within 0.0027 seconds; at a ratio of 1/16 the formation of the intermediate ferrihemoglobin-peroxide compound is complete after about 0.020 seconds; and at a ratio of 1/1.6 the formation of the intermediate is not yet completed after 0.83 seconds.

The rate of combination of catalase with ethyl hydrogen peroxide, hydrocyanic acid, and hydrofluoric acid was measured at pH 6.9 and 26-28°. The results are similar to those obtained with ferrihemoglobin. There is an indication that ferrihemoglobin combines faster with ethyl hydrogen peroxide than does the enzyme. Still, it is known that this substrate is more rapidly decomposed by the enzyme than by ferrihemoglobin. It must be kept in mind that the rates of the over-all reactions are small compared with the rate of formation of the labile intermediates. The governing factor in the catalyses is the speed of breakdown of the intermediates into the free catalysts and the product molecules.

A comparison of the results obtained in this work with the findings of the Cambridge workers (Hartridge, Roughton, Millikan) on the reaction of blood pigments (hemoglobin, hemocyanin) with oxygen and carbon monoxide indicates that the catalyst-substrate and catalyst-inhibitor reactions are slower under comparable experimental conditions.

(This article is based upon a seminar report presented at the Marine Biological Laboratory on August 17).

Dr. H. Irene Corey, research associate in zoology at the University of Pennsylvania, and Dr. William F. Diller, assistant professor of zoology at Dartmouth College, have announced their engagement. Both Dr. Corey and Dr. Diller have been registered in the Marine Biological Laboratory this summer.

Dr. J. M. Johlin, associate professor of biochemistry at Vanderbilt University Medical School, is planning to leave Woods Hole shortly to meet his family, who are returning from a trip to Europe.

Dr. Ray S. Snider left Woods Hole last week for the University of Nebraska, College of Medicine, where he has been appointed instructor in cytology. Heretofore Dr. Snider has worked under Dr. E. V. Cowdry at Washington University, School of Medicine. Dr. Snider's picture can be found on the snapshot page.

A shovelnose shark, estimated at 20 feet in length, was caught on August 2 in a fishtrap near Chatham. It was said to be the largest seen there in years.

The Collecting Net

A weekly publication devoted to the scientific work at marine biological laboratories

Edited by Ware Cattell with the assistance of Anna-Betty Clark, A. S. Cattell, Garnette McClure and Boris Gorokhoff.

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Introducing

Kazimierz Sembrat, docent of zoology and comparative anatomy, Faculty of Science; adjunct at the Zoological Institute, Lwów University; Rockfeller fellow at the Osborn Zoological Laboratory.

Dr. Sembrat was born in Kraków, Poland, in 1902. His university studies were carried on at Lwów, where, under Professor Hirschler, he received his doctorate on the transplantation of the gut in frog tadpoles. Since then his publications have dealt with three interests, the cytology of protoplasmic inclusions, experimental embryology, and the morphogenetic function of the endocrine glands.

He has received government fellowships for work at the biological stations at Roscoff, Villefranche (sur mer), and Plymouth. In 1931 he received a Rockefeller fellowship, spending the first part of the year at the University of Brussels where he worked with Professor Dalcq on the localization of the primary gonocytes in Axolotl. During the second part of the year he went to the Kaiser Wilhelm Institut für Biologie. Here with Dr. Mangold he studied the regeneration of the primary eye vesicles in Triton.

In 1936 Dr. Sembrat came to Dr. Harrison's laboratory at Yale on a second Rockefeller fellowship to continue his work on the localization of the primary gonocytes in frogs and Amblystoma. During the past year he has also studied mammalian embryos with Dr. Nicholas.

Dr. Sembrat will remain at Woods Hole working on the experimental embryology of the sea anemone until September, when he will return to Poland to resume his duties at Lwów University.

Ernst Hadorn, Rockefeller fellow in zoology and privat dozent at the University of Berne, Switzerland.

Dr. Hadorn was born in the Canton of Berne in 1902. His university studies were carried on at Berne, Munich, and Paris. He received the degree of Doctor of Philosophy from the University of Berne where, under Professor F. Baltzer, his research was on merogonic hybrids of amphibians.

In the fall of 1936 Dr. Hadorn came to this country on a Rockefeller fellowship. His first month here he spent at Harvard University, working with Dr. G. W. Beadle on the transplantation of material from lethal Drosophila larvae.

The remainder of this year was spent at the University of Rochester, where he continued his study of transplants with Dr. Curt Stern, also undertaking the problem of pupation. With Dr. Willier he has made chick transplantations.

In October Dr. Hadorn will return to Berne to teach at the University.

July 24, 1937

The Collecting Net,
Woods Hole, Mass.

Under separate cover I am sending you the copies of "The Biologist" for the last three years.

In doing so I am going back a year earlier than you suggested, but I rather think you would want to have a copy of Dr. Linton's charming reminiscences in your files.

If you wish to send me the "Collecting Net" for the same years, O.K.! If not, I shall take you at your word and throw in the issues of 1934-35 gratis.

I hope you are all having a great summer. My mind often wanders back to the good days at Woods Hole, the Club, the Choral Society, the Botany Trips, all now swamped in a maze of summer school teaching.

Sincerely yours,
A. M. KEEFE,
Editor of Biologist.

ADDITIONAL INVESTIGATORS

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CURRENTS IN THE HOLE

At the following hours (Daylight Saving Time) the current in the Hole turns to run from Buzzards Bay to Vineyard Sound:

Date	A. M.	P. M.
August 22	5:04	5:21
August 23	5:42	6:04
August 24	6:27	6:46
August 25	7:08	7:36
August 26	7:52	8:26
August 27	8:41	9:19
August 28	9:37	10:14

In each case the current changes approximately six hours later and runs from the Sound to the Bay.

ITEMS OF INTEREST

Dr. John Garth, of the University of Southern California presented on the evening of August 19 slides and motion pictures of the Hancock Expedition to the Galapagoes Islands. The birth of a seal, birds, iguanas, tortoises and the general fauna of the islands and the surrounding waters were shown.

Mr. Edwin Hiatt, graduate assistant in zoology at Duke University, who recently completed the course in physiology at the Marine Biological Laboratory, will work under Dr. W. R. Amberson this year, having received a research fellowship in physiology at the University of Maryland Medical School. Pictures of him can be found on the snapshot page.

Dr. George W. Kidder, instructor in zoology, College of the City of New York, has been appointed assistant professor of biology at Brown University.

Dr. Benjamin M. Duggar, who is a member of the research staff in the botany department at the University of Wisconsin, is spending a month at the Marine Biological Laboratory, his longest stay in several years.

Dr. Oscar W. Richards and family left Woods Hole on August 19 for Buffalo, where Dr. Richards is research biologist for Spencer Lens Co. A farewell tea was given him by the chemistry staff, as this concludes nine years of Dr. Richards' charge of the chemical room.

Dr. and Mrs. John Taylor will arrive in Woods Hole on August 23. The former is the recipient of a National Research Fellowship enabling him to work with Dr. Baird Hastings at Harvard Medical School in the coming year. Last summer Dr. Taylor was with the Eli Lilly Research Laboratories during his stay at the Marine Biological Laboratory.

On particularly humid days at the Laboratory the need of a drinking fountain makes itself clearly evident. It is a continual source of surprise to friends and relatives that nowhere on the premises can be found a cool fountain of gushing water. Beakers and other similar glassware do their best as a substitute.

Dr. E. Newton Harvey, professor of physiology at Princeton University, has returned to Woods Hole after attending the International Psychological Congress in Paris, before which he presented a paper entitled "Conditioning of the Alpha Rhythm of the Brain to Auditory Stimuli."

THE COLLECTING NET SUNDAY TRIPS

The first Collecting Net trip of the season consisted of an excursion to Penikese and Cuttyhunk on August 8. A cloudless, sunny day was ideal for the sixty-two pleasure seekers who left the Town Wharf in Eel Pond on the power-boat *Winifred*. The first stop, after passing through the Hole and along the chain of the Elizabeth Islands, was at Penikese Island. There the picnickers first examined the ruins of the school founded just a half century ago by Agassiz and whose continuation still exists today as the M. B. L. After some of the crew had taken a swim in the waters of the island, everyone ate their lunches. These varied greatly, since they had to be provided individually, but drinks, supplied by The Collecting Net, were plentiful and suitable to every taste. In the middle of the afternoon the boat left the island for Cuttyhunk, where some went swimming, some stayed on the boat, and some explored the island, discovering to their great delight an ice cream parlor. After the crowd had been reassembled, the boat returned to Woods Hole, bringing everyone home in time for supper at the Mess. Like the trip taken the next Sunday, the proceeds were devoted to the extra cost of printing the pages of snapshots in The Collecting Net. —*B. I. G.*

A mixed group of twenty-six laboratory people, both investigators and students, left at 9:30 on Sunday morning, August 15th, aboard the *Winifred* for Gay Head at the tip of Martha's Vineyard.

Whisperings of the beauty of the clay cliffs at Gay Head and of the interesting Indian colony there could be heard drifting from bow to stern during the hour and a half ride to the Vineyard, but it is certain that those who had never seen the cliffs were not prepared for the unbelievable grandeur and color which confronted them as the *Winifred* circled before the Head. Immediately after dropping anchor, there was a mad scramble for the hills. Exploring the winding paths and examining the varied-colored clay was certainly enjoyable, but no one seemed reluctant when, at two o'clock, it seemed time to explore the depths of each individual lunch box.

At four-thirty, the *Winifred* started homeward with its cargo of rather sun-tarnished Woods Holers, but not before a few of its passengers had found additional enjoyment in a cooling swim. Since Captain Smith piloted us into the Eel Pond at quarter of six, there was time for a quick change before supper at the Mess. The end of a perfect day! —*G. F. M.*

NOTES FROM OTHER BIOLOGICAL STATIONS

LA JOLLA CAMPUS

A series of free public lectures by members of the staff described in non-technical language the past and present activities of the Scripps Institution of Oceanography. The lectures were delivered on four consecutive Monday evenings, commencing July 12. They were:

July 12: (1) The history of the Scripps Institution; Dr. F. B. Sumner. (2) The present program of the Institution; Director H. U. Sverdrup. July 19: (3) Currents off the Coast of California; Dr. H. U. Sverdrup. (4) The bottom of the sea; Dr. R. H. Fleming. July 26: (5) The bacteria of the sea; Dr. C. E. ZoBell. (6) Minute plants and animals of the open ocean; Dr. Martin W. Johnson. August 2: (7) Life processes of the lower animals of the sea; Dr. D. L. Fox. (8) Life processes of the fishes; Dr. F. B. Sumner.

Director H. U. Sverdrup, Dr. G. F. McEwen, Dr. M. W. Johnson, and Dr. D. L. Fox attended the meetings of the American Association for the Advancement of Science in Denver during the week of June 21-26. Each presented one or more papers before different affiliated societies of the Association, and acted in various official capacities at business gatherings.

On the third oceanographic cruise of the California State Fisheries boat the *Bluefin*, a continuation of the scientific work in charge of Dr. E. G. Moberg, was carried out during the third and fourth weeks of June with the assistance of Robert Gordon and Gilbert Hofeller.

On Tuesday evening July 6, at 8:00 p. m. Dr. H. U. Sverdrup gave an illustrated lecture at the Scripps Institution for the public, on the subject, "Exploration of the Arctic Ocean by submarine." Dr. Sverdrup told of his voyage to the Arctic regions in the submarine *Nautilus* with Sir Hubert Wilkins' expedition in 1930; he discussed experiences and scientific findings on the expedition, and explained how, on the basis of those investigations, plans may be made for considerable extension of such explorations.

Visiting investigators at the Scripps Institution are Dr. E. M. Thorp, formerly of the Scripps Institution, now assistant professor of geology at Baylor University, Texas; Dr. J. S. Butts, assistant professor of biochemistry at the University of Southern California who is studying some aspects of the metabolism of marine mollusks with Dr. D. L. Fox; Dr. Robert T. Young, Jr., instructor in physics from Worcester Polytechnic College, Mass., who is continuing his investigations of the penetration of sunlight into sea water in Dr. G. F. McEwen's department; Mr. W. Forest Whedon, formerly of the Hooper Foundation for Medical Research, who is now engaged in studies of antifouling marine organisms in cooperation with the U. S. Navy; Captain J. Drent from the Parisian Steamship Company who is engaged in special studies in oceanography.

Dr. William G. Clark, who recently received his doctorate degree in plant physiology under Dr. F. W. Went at the California Institute of Technology has arrived as research assistant to Dr. D. L. Fox in the absence of Bradley T. Scheer, who will pursue graduate studies at Berkeley during the coming academic year.

L. I. Katzin, graduate student in physicochemical biology, from Berkeley, is pursuing some graduate research work under Dr. Fox during the summer session. H. L. Blum, student from Berkeley, is assisting Dr. Fox and Dr. ZoBell on some combined problems in marine biochemistry and microbiology during the summer. W. M. Lewis is investigating some problems in marine biology under the supervision of Dr. M. W. Johnson.

On June 23, Dr. C. E. ZoBell gave an illustrated lecture to members of the California State Veterinary Medical Association in Long Beach, on the subject "Some practical aspects of marine microbiology."

Recent visitors to the Scripps Institution include: Professor George E. MacGinitie, in charge of the Kerckhoff Marine Biological Laboratory of the California Institute of Technology; Mr. Boyd B. Rakestraw, assistant director of the University Extension Division and the southern district executive secretary, Miss Margaret Wotton, who conferred with Dr. ZoBell concerning science courses which will be offered during the coming year in La Jolla and San Diego through the Extension Division; Mr. Milton Silverman, science editor for the *San Francisco Chronicle* and in charge of the scientific exhibit in the coming San Francisco Exposition.

NOTES ON THE UNIVERSITY OF WASHINGTON OCEANOGRAPHIC LABORATORIES AT SEATTLE AND FRIDAY HARBOR

Research investigators for the summer include: Dr. Phil E. Church (meteorology), Dr. John E. Guberlet (embryology), Dr. Bernard S. Henry (bacteriology), Dr. Robert C. Miller (invertebrate zoology), Dr. Earl R. Norris (biochemistry), Dr. Lyman D. Phifer (diatoms), Dr. George B. Rigg (plant physiology), Dr. Rex J. Robinson (oceanographic chemistry), Dr. Clinton L. Utterback (physics), Dr. Thomas G. Thompson (oceanographic chemistry). All of the University of Washington. Dr. Anna Church (biochemistry), University of Alabama, Dr. Guillermo Mendoza (zoology), Northwestern University, Dr. Otis Wade (zoology), University of

Nebraska, Dr. Elsie Wieczerowski (zoology), Northwestern University. Kelshaw Bonham (zoology), Randall Ham (chemistry), Daniel Helms (zoology), Joe Goodman (chemistry), Eugene Miller (physics), Rose Ostroff (bacteriology), Lloyd West (chemistry), Robert Williams (botany), and Benjamin Zwicker (chemistry). All of the University of Washington.

Two new members have recently been added to the staff as Lecturers in Oceanography, Commander F. A. Zeusler of the United States Coast Guard, and Commander O. W. Swainson of the United States Coast and Geodetic Survey.

Two graduate students of the Oceanographic Laboratories have accompanied Commander Zeusler to Bering Sea and the Arctic Ocean on the Coast Guard Cutter *Northland*. Various dynamical sections will be established in the northern waters and the physical and chemical properties will be studied.

The Motor Ship *Catalyst* will make a detailed study of the waters of Dixon Entrance and to the westward of the Queen Charlotte Islands. The establishment of various stations beyond the continental shelf of Oregon, Washington, and British Columbia will be attempted later in the season.

The registration in the courses given at the two Laboratories is about ten per cent. greater than that of last year.—*Thomas G. Thompson, director.*

NOTES AND NEWS FROM M. B. L. CLASSES

BOTANY CLASS NOTES

Marine collecting for mounting has taken the laboratory like a contagious disease. The fish are to be envied on hot days by ordinary folk but to the botanists he's an object of wonder, for what wouldn't we give for a pair of fins to escort us through the flora of the hidden depths.

Although the invertebrate members of the spineless class were discouraged by the weather on Wednesday and stayed at home, the botany class, with many of its members present, started out at one o'clock on Thursday for a field trip The weather turned out beautifully and so too did the collecting. Although not so many genera were found still great quantities of Tolypothrix and Oedogoneum were collected.

Saturday morning, bright and early, after a still earlier visit to the Mess Hall, the class started out on the first marine field trip; all those heretofore being fresh water trips. This time the two longs and two shorts for the drawbridge were not heard, for we were scattered in three row boats. Settling in on Nonamesset and Pine Islands we started our search from cove to cove over the barnacle covered rocks. People say barnacles don't bite. I believe some of the members of the class will agree that they do—the barnacles, I mean. In order to make the going easier buckets were often floating in the water along with the collector. When Dr. Taylor called out the name of some marine form, members of the class could be seen (and heard) scrambling across the barnacle coated rocks. The great success of the trip can be demonstrated by the fact that between seventy-five and eighty species were found and (we hope) mounted.

Now that we are taking to the Phaeophyceae (brown algae) under Dr. Taylor some of these algae mean more to us—still it is rather embarrassing when you ask the name of some marine form you had just studied in the lab the day before.

All agree that collecting and mounting is great sport and we are looking forward to future marine trips. However, when one considers that 100 different species per person is the goal we sometimes wonder where we'll find the ninety-ninth, not to mention that loveliest of all lovely things, the one-hundredth specimen. —*J. P. H.*

INVERTEBRATE CLASS NOTES

A "Diet of Worms" has unexpectedly proved palatable weekly fare for our group of invertebrate scientists. For three days, Dr. Hadley offered us hasty glimpses into the private lives of nematodes and flat worms and suggested dissections of the encysted metacercaria of *Cryptocotyle lingua*—a task which tried to the utmost the patience and skill of all of us.

With Dr. Sayles we have scanned the whole annelid phylum, with special attention turned on the Polychaetes of the Woods Hole region. Prepared slides to compare parapodial types in these annelids were our next objects of study, but by far the most popular work was our observation on the developing eggs of the living Hydroides hexagomes.

And we tried to maintain our necessary balance of physical activity too. For Managers Crowell and Rankin organized two promising baseball teams, the South Shore Ctenophores and North Shore Nematodes respectively but our game, worse luck, was never played. Our only exercise was the hike to and from the crowded ball park. Furthermore, rough weather on Thursday caused instructors to postpone a dredging trip for the benefit of mid-westerners. But here's some fun —ask the salty old easterners what they thought of the exhaust and grating dredge on Saturday morning. —*S. W.*

DEPARTMENT OF PUBLICATIONS

PHYSIOLOGY IN HEALTH AND DISEASE. By Carl J. Wiggers. 2nd Edition. 1937. Lea and Febiger, Philadelphia.

The second edition of this publication retains the objectives of the first edition viz.: a work "primarily to meet the needs of medical students, clinicians and progressive practitioners of medicine." It is essentially a human physiology and in this field is a medical handbook with no pretense to the biological status of general physiology. The sections on heart and circulation are monographic and highly technical in character and thus reflect the author's eminence in this field. Such presentations constitute a desirable reference work for graduate students, in fact the commendable critical digest of the most recent literature, referred to throughout the revision, constitutes a valuable convenience even to trained workers as well as to clinicians; it is no work for the novice although the material is presented in a clear logical way. In the latter respect the second edition is a distinct improvement on the original edition; many errors both of fact and typography, inevitable in a first edition, have been eliminated,—a few still stand. The discussions of the special senses, pulmonary affections and neurohumoral agents have been expanded, the last named topic conservatively, as is fitting in its present state of flux. The publisher's prospectus states that the "new edition contains a wealth of information" and "is a storehouse of critically selected information" of value to the physiologist, the clinician and pathologist; to this the reviewer would add—: to the medical student, for Wigger's Physiology will be a signal addition to his working library.

—*W. E. Garrey*

TIME OF OVULATION IN THE MENSTRUAL CYCLE

Dr. Carl G. Hartman

Research Associate in Embryology, Johns Hopkins University Medical School

In the monkey the egg is discharged from the ovary around the fourteenth day of the menstrual cycle. In 150 cases it never occurred before day 9 nor after day 20. These ovulations were accurately determined by digital palpation per rectum and in half of the cases this was checked by recovery of the eggs or embryos afterwards. Aside from five eggs recovered from the human tubes by Allen and Pratt these data on the monkey are the only reliable ones thus far gathered on ovulation time in any private. Additional data are furnished in the monkey from inspection of the ovaries and isolated coitus with subsequent pregnancies, two methods that have also been applied to women. However, the former method by itself is not reliable as there are no good criteria for age of corpora lutea in the first place; and in the second, while isolated coitus can be relied upon under conditions of a monkey colony, reports by humans on their sex habits are too unreliable to warrant wholesale conclusions on the fertile and so-called "safe" period in women. Refractoriness of the uterus to pituitrin when corpus luteum secretion is present and hence ovulation may be predicated has likewise pointed to ovulation in women between days 9 and 20.

How the monkey mother gives birth to its baby, the grasping reaction of the newly born, the cleaning of the baby by the mother and the eating of the afterbirth were shown in a film which is the composite of three parturitions. The Carnegie film showing cleavage of the monkey egg was also shown.

(This article is based upon a lecture presented at the Marine Biological Laboratory in 1935).

THE HARBOR FLAGS

In response to a query signed "Curiosa," we interviewed a member of the local yacht club about the flags flying there. The flagpole system is designed to correspond to the arrangement on a yacht, with the U. S. flag flying on the boom, analogous to the stern. In the mainmast position is the Woods Hole Yacht Club burgee while the crosstree carries the flag of the Southern Massachusetts Yacht Racing Association. As originally used, the whale on the latter banner was maintained in such a position that the tail wagged the rest, but considerable comment and limited marine observation evoked a change to a situation deemed more natural. A one-sided compromise with the sun permits the flags to be raised at 8:00 A. M. with an accompanying salute, while the lowering hour is sunset as determined by the "Farmer's Almanac" (complicated by a dinner hour).

We learned that the yachts, in addition to the U. S. flag on the stern, the yacht club flag on the mainmast and the owner's flag on the foremast, carry other flags for occasional use. The small dark blue flag on the starboard side of the mainmast crosstree indicates that the owner is not aboard. A New York firm are said to advertise a cocktail flag which indicates that other things beside the owner are aboard, while the same flag hung upside down asks "Anybody got a drink?"

PROGRAM OF THE SUMMER MEETING OF THE GENETICS SOCIETY OF AMERICA AT THE MARINE BIOLOGICAL LABORATORY, AUGUST 30 TO SEPTEMBER 1, 1937

Officers of the Genetics Society of America

President, E. M. East, Harvard University.
Vice-President, L. J. Cole, University of Wisconsin.
Secretary-Treasurer, M. Demerec, Carnegie Institution of Washington, Cold Spring Harbor.
Local Representative, P. W. Whiting, University of Pennsylvania.

Monday Evening, August 30, 8:00 P. M., Auditorium

Marine Biological Laboratory Evening Lecture

Dr. Boris Ephrussi, Institut de Biologie physico-chimique, Paris. Aspects of the physiology of gene action.

Tuesday Morning Session, August 31, 9:30 A. M. Auditorium

Round table conference: Different methods of study as applied to problems of genetics; results and purposes.
Leader, L. C. Dunn, Columbia University.

(1) Descriptive methods in development.

Introducers:
- E. W. Sinnott, Columbia University.
- H. B. Tuckey, New York State Experiment Station.
- D. F. Poulson, Yale University.
- W. Landauer, Storrs Agricultural Experiment Station.

Tuesday Afternoon Session, August 31, 2:00 P. M., Old Lecture Hall

Demonstrations and Exhibits

(1) Beers, Catherine V., University of Southern California. Demonstration of mutants of *Drosophila pseudo-obscura* race B.

(2) Berger, C. A., Woodstock College, Woodstock, Md. Prophase pairing in somatic cells with multiple chromosome complexes.

(3) Blakeslee, A. F., A. G. Avery and J. L. Cartledge, Carnegie Institution of Washington, Cold Spring Harbor, N. Y. Induction of polyploids in *Datura* and other plants by treatment with colchicine.

(4) Blanc, R. and G. P. Child, Amherst College. The effect of high temperature on the "truncate reaction" in *Drosophila melanogaster*.

(5) Brehme, Katherine S., Columbia University. The time of death of three Minute homozygotes in *Drosophila melanogaster*.

(6) Brehme, Katherine S., Columbia University. The growth curve of Minute larvae.

(7) Bridges, C. B., Carnegie Institution of Washington and California Institute of Technology. Revision of salivary map of X-chromosome of *Drosophila melanogaster*.

(8) Cameron, John A., Harvard University. Hair color changes in mice as indicators of the spread of x-ray effects.

(9) Carlson, J. Gordon, University of Alabama. Some effects of x-radiation on somatic chromosomes of *Chortophaga viridifasciata*.

(10) Davenport, Chas. C., Carnegie Institution of Washington, Cold Spring Harbor. How family resemblance of features is brought about.

(11) Eyster, H. Clyde, Carnegie Institution of Washington, Cold Spring Harbor. Natural mutation rate in corn.

(12) Green, E. L., Brown University. The inheritance of costal and vertebral variations in the rabbit.

(13) Guyer, M. F., F. E. Mohs and P. E. Claus, University of Wisconsin. Inheritance of resistance to transplantable cancer in rats.

(14) Huettner, A. F., and B. P. Sonnenblick, Washington Square College, New York University. Cytology of the egg of *Drosophila melanogaster* following x-radiation.

(15) Humes, Arthur G. and Paul B. Sawin, Brown University. Homeotic variations in the axial skeleton of *Mus musculus*.

(16) Huskins, C. L., A. M. S. Hunter, H. B. Newcombe and G. B. Wilson, McGill University. Chromonema and chiasma studies in asynaptic, desynaptic and normal *Trillium erectum*.

(17) Jones, D. F., Connecticut Agricultural Experiment Station. Variegation resulting from unequal mitosis.

(18) Kaufman, B. P., Carnegie Institution of Washington, Cold Spring Harbor. Complex chromosomal rearrangements following x-radiation of sperm of *Drosophila melanogaster*.

(19) Kimball, R. F., Johns Hopkins University. The determination and inheritance of sex at endomixis in *Paramecium aurelia*.

(20) Lawson, Chester A., Wittenberg College. Order and time of embryonic differentiation in relation to order of determination in gamic female aphids.

(21) MacKnight, R. H., California Institute of Technology. Cytology of *Drosophila miranda*.

(22) Nebel, B. R. and M. L. Ruttle, New York State Agricultural Experiment Station. Action of colchicine on mitosis.

(23) Plough, H. H. and G. P. Child, Amherst College. Autosomal lethal mutation frequencies in *Drosophila melanogaster*.

(24) Riley, Herbert Parkes, Newcomb College, Tulane University. Interlocked bivalents as a cause of polyploid pollen grains.

(25) Russell, Elizabeth Shull, Jackson Memorial Laboratory. A quantitative study of genic effects on guinea-pig coat color.

(26) Sawin, P. B., K. M. Wheeler, C. A. Stuart and A. M. Griffin, Brown University. Inheritance of normal agglutinins for human erythrocytes in rabbit serums.

(27) Spencer, Warren P., College of Wooster. *Drosophila virilis americana*, a new sub-species.

(28) Sonneborn, T. M., Johns Hopkins University. Sex behavior, sex determination, and the inheritance of sex in fission and conjugation in *Paramecium aurelia*.

(29) Sonnenblick, B. P. and A. F. Huettner, Washington Square College, New York University. Cytology and development of a star race of *Drosophila melanogaster*.

(30) Steele, Dewey G., Connecticut State College. A colorimetric method for the quantitative study of melanin in feathers.

(31) Sturtevant, A. H., California Institute of Technology. The homologies of the chromosome arms of different species of Drosophila.

(32) Whittinghill, M., California Institute of Technology. Oogonial crossing over in *Drosophila melanogaster*.

Tuesday Evening, August 31, 5:00 P. M.

Excursion on the boat *Winifred* and Clam Bake at Tarpaulin Cove. Boat will sail from the Eel Pond. Swimming for those who desire.

Wednesday Morning Session, September 1, 9:30 A. M., Auditorium

Continuation of Round table conference.

(2) Methods of experimental morphology.

Introducers:
- E. Hadorn, University of Bern, Switzerland.
- B. Ephrussi, Institut de Biologie physico-chimique, Paris.

(3) Radiation.

Introducers:
- D. G. Catcheside, John Innes Horticultural Institution, England.
- M. Demerec, Carnegie Institution of Washington, Cold Spring Harbor.

THE CHESAPEAKE BIOLOGICAL LABORATORY

Dr. R. V. Truitt, *Director*

A need for basic facts on important Chesapeake Fisheries and for a wider appreciation of water resources on the part of Maryland citizens prompted the founding of the Chesapeake Biological Laboratory in 1923. Through the Laboratory's efforts in oyster research the importance of the institution soon became recognized, and in 1932 the present well-equipped building was formally opened. Since that time the work of the Laboratory has been in two directions; namely, teaching and research. The courses offered deal primarily with the subject matter of marine biology, the following usually being offered every year: diatoms, invertebrate zoology, algae, ecology, economic zoology, physiology, and ichthyology. Requests for these courses are numerous and widespread. A maximum of eight students is permitted to register for a course. Independent research is encouraged. Students are not accepted for work unless their records indicate special aptitude and interest. Being situated almost midpoint on the Chesapeake Bay, at the mouth of the Patuxent River, it is truly a brackish water laboratory in which fauna studies, life history work, growth problems, physiological and hydrographical investigations are tempered by the salinity factor. The trend of original study may be best shown, perhaps, by a description of the program for this year.

The director for some years has been engaged in problems pertaining to the growth and conditions for development of the oyster and crab. He is continuing this work while concentrating on the early stages in the development of the blue crab and problems of crab migration. Associated with him in this work is Mr. Roy Robertson. Another life history study which was begun several years ago by the same worker, continued in 1933 with Dr. E. J. Papenfuss, is that of the common sea nettle, *Dactylometra quinquecirrha.* This work has progressed to a point where the complete development, from egg through strobilization and ephyra, of the nettle has been established under controlled conditions. The problem is now being carried on by Mr. Robert Littleford, of the University of Maryland.

Dr. V. D. Vladykov, ichthyologist, on leave of absence, Biological Board of Canada, is engaged in an intensive study of the biology of the striped bass, *Roccus lineatus,* and the shad, *Alosa sapidissima.* Associated with him in this work are Messrs. David Wallace and Edgar Hollis, who are engaged in field operations and in analysis of foods, length frequencies, and growth rates.

Dr. Marcus Old, of Ursinus College, who is offering a course in economic zoology, is, in addition, studying the variations in the boring sponge fauna of the Bay with reference to life history, taxonomy, and distribution.

Mr. Paul S. Conger, research associate of the Carnegie Institution of Washington, is in charge of the diatom work of the Laboratory. In addition to offering a course in diatoms, Mr. Conger is studying the local diatom populations and in this connection is cooperating with Dr. C. L. Newcombe who is conducting a hydrographic and biological study of at least two years duration in which particular stress is being given to the effect of the Patuxent River area on the productivity of the nearby Chesapeake Bay water. Also associated with Dr. Newcombe in this work are Mr. B. B. Shepherd, whose interest is centered largely in the seasonal variations in the copepod and diatom populations, and Messrs. Joseph S. Lann and Gordon Dittmar, of the department of chemistry of the University of Maryland.

Dr. Harold C. Bold of Vanderbilt University, has charge of algological work at Solomons Island and is surveying the local flora in this field as well as offering a formal course in this branch of botany.

Doctors R. P. Cowles and Charles Bramble, of the Johns Hopkins University, have under way an extensive study of methods of water analysis in which not only old methods are being tested out to determine their practicability and reliability, but effort is being directed toward the perfection of more effective and simpler methods of sampling and analysis.

A biological survey of the region of the Island is being conducted at the Laboratory. This survey is comprehensive in outline and planned as a project of several years' duration. All members of the staff assist, as time permits, in the work of collecting, preserving, and classifying the biological material. In charge of this work is Dr. Coleen Fowler of Greensboro College who, in addition, is in charge of instruction in invertebrate zoology, being assisted by the entire staff.

The work of the Chesapeake Biological Laboratory is sponsored by certain educational institutions, the Carnegie Institution of Washington and the Maryland Conservation Department. The cooperating colleges are Goucher College, the Johns Hopkins University, Western Maryland College, Washington College, and the University of Maryland. The Executive Committee is composed of the presidents of the schools named, while the policies for research and instruction are determined by a committee as follows: Mr. Paul S. Conger, Carnegie Institution of Washington; Dr. Gairdner B. Moment, Goucher College; Dr. R. P. Cowles, the Johns Hopkins University; Dr. Julian D. Corrington, Washington College; Dr. Lloyd Bertholf, Western Maryland College; and man. Dr. C. L. Newcombe is in charge of the Laboratory's research program.

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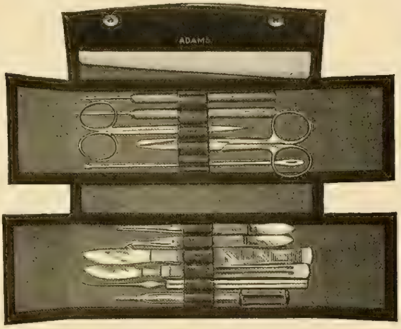

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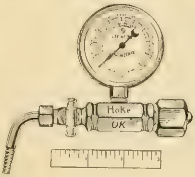

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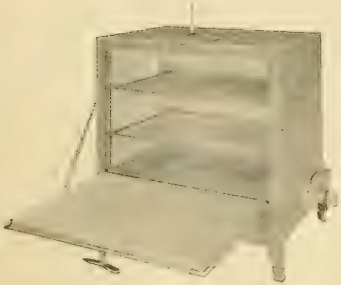

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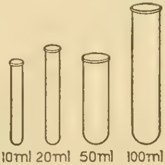

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WOODS HOLE LIFE IN HALF-TONE

Top Row: Dr. Alfred Lucas finds, examines, and gives Americium to Dr. Merriam Scott Lucas. **Second Row:** The end of a perfect day; Jean Shumway (daughter of Dr. Waldo Shumway, professor of zoology, University of Illinois); Sails set in the west; Snider sleeps. **Third Row:** Dr. H. S. Jennings; Dr. Ethel Browne Harvey; Dr. Robert Chambers at the window in the Mess Hall Lobby. **Fourth Row:** Boris and Galina Gorokhoff; Dr. Paul S. Henshaw with his two children; Eunice Stunkard (winner of the Junior Tournament of the M. B. L. Tennis Club).

(Photographs taken with a Zeiss Ikon Super Ikomat).

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THE COLLECTING NET

Vol. XII, No. 9 SATURDAY, AUGUST 28, 1937 Annual Subscription, $2.00 Single Copies, 30 Cents.

DEPOLARIZATION OF MEMBRANES BY ORGANIC COMPOUNDS

DR. RUDOLF HÖBER
Visiting Professor of Physiology, University of Pennsylvania

AND DR. BERNARD R. NEBEL
Research Associate in Cytology, New York State Agricultural Experiment Station

It is fairly generally accepted that some surface film of muscle and nerve fibers is the seat of a polarized state resulting from the high content of the interior of the fibers in free K ions and from the selective permeability of this film to cations. Furthermore, it is believed that the negative electric wave sweeping along the fibers after excitation is indicative of a local and reversible propagated depolarization due to an increase of ion permeability. This increase would be the result of an electrochemical reaction, which involves a structural alteration of the surface film. Since the excitation process has been shown to be connected with an increased metabolic activity of the fibers, it seemed worthwhile studying, whether organic compounds either identical or

(*Continued on page* 213)

Calendar

(Tentative)

Thursday, September 2

Dance: Gables Casino, Falmouth Heights

Friday, September 3

Dennis Players: Community Hall

Saturday, September 4

Carnival: Base Ball Park

Monday, September 6

Carnival: Base Ball Park

Street Dancing: Base Ball Park

THE SUBMARINE CANYONS OF THE CONTINENTAL SHELF

DR. HENRY C. STETSON
Research Associate in Palaeontology, Harvard University

The recent discoveries of many large canyons cutting the merged margins of the continents has precipitated a geological controversy of major proportions. Not only are many of these submarine valleys the equal in degree of relief to the deepest examples found on land, such as the Grand Canyon of the Colorado, but their distribution is world wide. A few of them were vaguely indicated on the older charts, but not until the modern development of echo sounding did we obtain accurate knowledge of their true configuration. Wherever adequate surveys are being carried out by sonic methods new ones are constantly being revealed.

They are found off the eastern coast of North America from the Grand Banks of Newfoundland to Cape Hatteras and on the west coast from Vancouver Island to southern California. More than thirty occur on Georges Banks alone. Others have been discovered in the Gulf of Mexico; off the western coast of Mexico;

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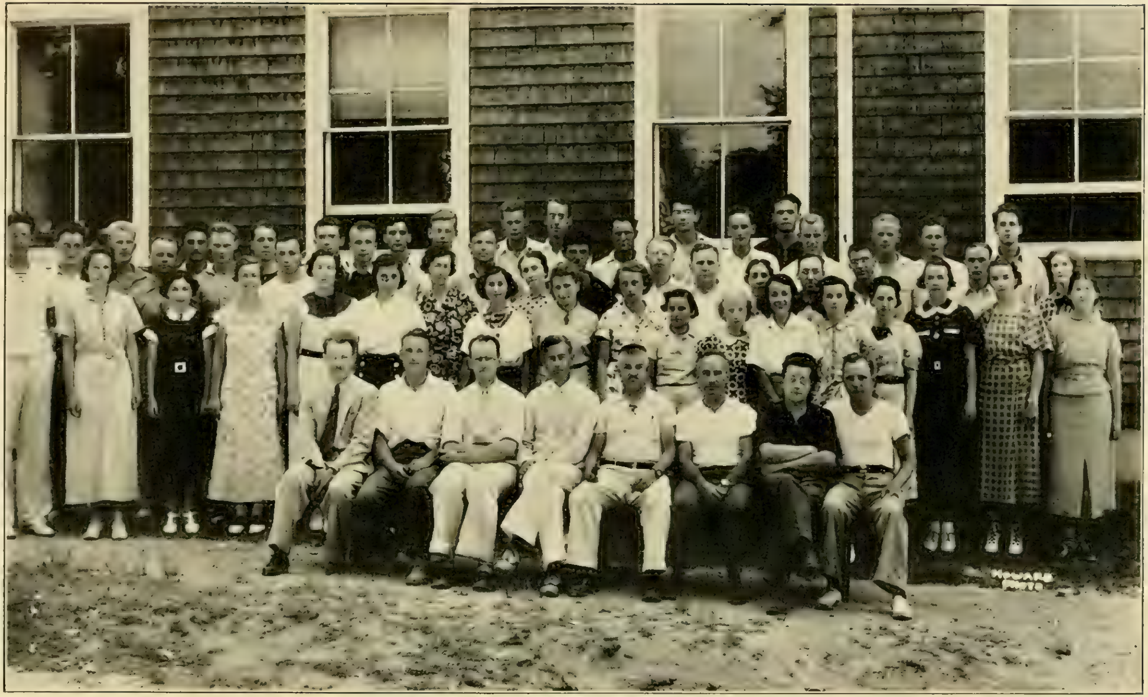

INVERTEBRATE CLASS

Front Row: Dr. A. M. Lucas, Dr. Sears Crowell, Dr. A. J. Waterman, Dr. S. A. Matthews, Dr. Bissonnette, (director of the course), Dr. C. E. Hadley, Dr. L. P. Sayles, Dr. F. R. Kille. **Middle Row:** Ruth M. Merwin, Jean Orange, Harriet M. Dana, Florence M. Martindale, Villa E. Bailey, Mabel A. Barkley, Mary Goodline, Myra Williams, Lucille Marrow, Ruth M. Schneider, Esther Eisenberg, Helen J. Ramsey, Margaret P. MacBride, Sally Walker, Evelyn M. Kuhn, Dorothy Perry, Marian Johnson, Elizabeth Kurtz. **Back Row:** Chauncey G. Goodchild, Donald R. Griffin, Harold H. Haskin, Curtis H. Bottom, Sam Dvoskin, Charles M. Berry, Hiram J. Evans, William R. Carroll, James G. Wilson, Kenneth Fink, Howard L. Hamilton, "Mr. I don't know," Cazlyn G. Bookhout, Wilhelm S. Albrink, Albert Barden, Carl P. Swanson, Horace J. Sawin, Albert Miller, Morris Rockstein, Eldon J. Strandine, Ross A. Gortner, Jr., Filomena G. Müller, William A. Müller, John P. O'Brien, Dewey G. Steele, Lauren C. Gilman, Carl F. Holthausen, Jr., John Wightman, Kenneth L. Osterud, Charles M. Harrold, Josephine Bridgman.

the coasts of Brazil and Ecuador; the eastern coast of Korea; on both sides of Japan; off Formosa and Ceylon; off the mouths of the Indus and Ganges Rivers; off the east coast of Africa; south of Zanzibar; off the coast of South Africa; opposite the mouths of the Congo and Niger Rivers of central Africa; off the Gold Coast and Cape Verde; and off the coasts of Portugal, France and the British Isles. They have even been reported from the Hawaiian Islands.

The canyons, once their configuration is known, immediately presented themselves as one of the most extraordinary anomalies that confront geologists today, not only because of their magnitude and distribution, but chiefly because of the as yet unanswerable problems to which they give issue. To account for their origin we are faced with the dilemma of altering the relationship of land and sea to a seemingly impossible extent, or else appealing to submarine currents whose behaviour is utterly at variance with the data which modern physical oceanographers are accumulating. Yet there they are—huge valleys extending to more than 10,000 feet below present sea level—produced by forces not local or regional in their scope, but which operated simultaneously the world over and within comparatively recent times.

The United States Coast and Geodetic Survey charted Georges Banks in 1932 for the benefit of the fishing industry. Sonic sounding methods were used and it is to them that we owe the detailed charts which have been so useful in the dredging program which has been carried on by the Woods Hole Oceanographic Institution.. This survey and subsequent ones are the most accurate that have ever been carried on outside of land. Three or four ships were used simultaneously as the charting was carried further from shore and fixed marks were left behind. Two or more ships would be anchored, the vessel taking the soundings would steam ahead, dropping bombs at stated intervals. The echo transmitted by the water would be picked up by the hydrophones on the anchored vessels and relayed by wireless to the ships taking the soundings, thus enabling them to constantly check their position. When several traverses had been completed, the anchored vessels would take up new positions further seaward.

There are two main types of canyons which cut the margins of the continental shelf. The first type are from five to twelve miles in length, two to six in width, and range approximately 8,000 to 10,000 feet below present sea level. In places the valley bottoms lie nearly a mile below the canyon rims. They are v-shaped in cross-section and have a continuous downward gradient. The heights of this first type rarely come above 50 fathoms and they are not connected by any of the established drainage systems on shore. All those on Georges Banks fall in this category as indeed do most of those on the Atlantic and Pacific Coast.

The second type are found off large rivers. We have the same steep outer gorge in the continental ledge, but leading across the nearly level parts of the ledge is a broad shallow groove connecting the outer gorge with the river mouth. An example of this is the classic case of the Hudson, which has been known for a great many years; but valleys of this type also exist off the Indus, the Congo and the Niger.

The walls of these canyons are so steep that in a great many places they are above the angle of repose of unconsolidated sediment. Consequently the strata which make up their walls must be indurated. If samples could be obtained at the place of these sedimentary formations and should they contain fossils, we would have a means of at least fixing the maximum age of valley formation and at the same time find out something about the material which underlies the surface of the continental shelf.

Consequently, for two successive summers the *Atlantis* has conducted dredging operations in all the canyons from Georges Banks to the Chesapeake.

Dredging operations are carried on in the following manner. The edge of a canyon would be located by echo soundings and a buoy placed on it. The vessel would proceed slowly toward the middle of a canyon until a steep cliff had been crossed. The course would be reversed, the dredge lowered and the depth recorded. The ship would then go ahead at about two knots laying out wire at the same speed to avoid kinking, the dredge meanwhile remaining stationary. Experience showed that about one mile of wire was necessary to insure a good angle of drag for this type of work at the depth at which the cliffs were found. The winch was then stopped and the vessel allowed to fetch up on the dredge and drag it up the face of the cliff. The towing wire of the main winch runs over a combination meter wheel and strain indicator. By watching the latter instrument the operator could always tell when he was scraping through recent unconsolidated material or when he had encountered more indurated deposits. In the former case even though cutting through glacial outwash with erratics a foot in diameter the strain never went over 3,000 pounds. When the older, more consolidated deposits were encountered the strain varied from about 7,000 pounds to somewhat over 10,000 pounds. During the course of a tow the tension on the wire would often approach the maximum and then suddenly lessen as the dredge crossed successive outcrops breaking pieces on the way. This explains why a single tow often yielded fragments very different in lithology and fauna. At times the dredge would anchor itself securely enough to check the vessel's headway. It is obvious that loose fragments could never have subjected the gear to such heavy strains as those noted above. As additional evidence that the fragments were taken in place, freshly broken faces as well as weathered ones were usually found in the same specimen.

Tows were always made uphill and only the lower and upper limits could be recorded since the vessel was far ahead of the dredge. It is not possible therefore to fix the exact depth at which any single formation was encountered. The vertical range of each tow, however, was not great and in no case amounted to more than 128 meters.

The fossileferous strata obtained from the canyon walls indicated that the east coast canyons cannot be other than Pliocene.

Geologists, by and large, are able to explain anything, provided it happened very long ago. Given sufficient time, much of the evidence will have been obliterated and there will be less to invalidate a given hypothesis. These submarine canyons, as I have said, have been known in a general way for a long time and nobody thought much about them. It was assumed that they were stream cut and the uplift necessary to produce them could easily be relegated to the period of the Appalachian Revolution, if indeed anybody cared to date them. Consequently, they were of minor importance, with no more significance than any deep, stream cut gorge. Recent evidence, however, indicated that they are young and in their very youth lies their significance. For if these valleys are the work of streams, either the Continental margins have risen uniformly a matter of 8,000-10,000 feet, or the sea has dropped an equivalent amount, or powerful and mysterious agents have been operative about which we know nothing and these events have occurred only yesterday and right in our own door yard.

The theories which have been advanced to explain the origin of these canyons, fall into two main categories. First: those which explain them by the action of submarine currents; second: those which call upon stream erosion. In an effort to obtain some data on present day currents, tidal and otherwise, which may be flowing in the east coast canyons some direct measurements were made last summer with an Ekman current meter by the Woods Hole Oceanographic Institution in the bottoms of three canyons on Georges Banks.

Currents not exceeding 0.2 knots were recorded. Consequently, although the velocities obtained may be sufficient to prevent the deposition of present day sediment, they would be powerless to cut through material of which the continental shelf is composed.

Another type of current has been proposed by Professor R. A. Daly, which has recently received considerable support. He appeals to sediment in suspension to obtain the differential densities to make his current flow. According to his theory such a situation must have arisen during the lower sea level of Pleistocene times, when large areas of soft deposits formerly below wave base were placed within reach of wave scour. This heavy water would first seek the lowest depressions on the shelf surface such as might be caused by initial irregularities. It would run down them and eventually would flow over the steeper gradient of the continental slope with greatly accelerated motion, thereby cutting the canyons. Numerous factors remain to be evaluated, such as the amount of energy available for the work, the relative hardness of the ground to be cut and the effect of the lighter water near shore. It is a mechanism which, given the proper conditions, could be made to work.

If these valleys are cut by rivers or streams it is of course necessary to either raise the borders of the continents a matter of 10,000 feet or more or else lower the sea level an equivalent amount. F. P. Shepard supposes that the ice caps were vastly greater than has hitherto been supposed. In addition he would enlarge the north polar cap by completely freezing over the Arctic Basin and using it as a platform on which more snow and ice could accumulate. Recent work along the Siberian Coast supports this view.

At best, sea level could only be lowered 2,000 to 3,000 feet by this method and we still have to account for the lower parts of these valleys.

As I have said there are many canyons which are not connected with the major river systems. If sea level can be lowered this type of valley would be similar to the short box-like canyons which are found in any plateau country. Starting from the face of a scarp, these valleys work headward and side-ways by a process of ground water sapping, the ground water running out along the top of impervious formations and undermining those above. Valleys of this type are clearly indicated on many quadrangles of the Geological Survey. The Bright Angel quadrangle of the

(Continued on page 226)

THE COLLECTING NET has been entered as second-class matter July 11, 1935, at the Post Office at Woods Hole, Massachusetts, under the Act of March 3, 1879. It is devoted to the scientific work at marine biological laboratories. It is published weekly for ten weeks between June 1 and September 15 from Woods Hole and printed at The Darwin Press, New Bedford. Its editorial offices are situated on the third floor of the Woods Hole station of the United States Bureau of Fisheries. Between June 1 and October 1 communications should be addressed to Woods Hole, Massachusetts; at other times they should be directed to THE COLLECTING NET, Garrison, N. Y. Single copies cost 30c; a subscription (containing not less than 280 pages) costs $2.00.

DEPOLARIZATION OF MUSCLE AND NERVE MEMBRANES BY ORGANIC COMPOUNDS

(Continued from page 209)

more or less related to normal constituents of the fibers would bring about depolarization.

Experiments were performed on sartorius muscles and sciatic nerves of the frog, complemented, in cooperation with Dr. M. Andersch, by studying nerves of the spider crab. Injury potentials were measured, following the usual procedure.

The experimental result is this, that not only certain organic cations, comparable to the normally penetrating K ions, but also certain organic anions and nonelectrolytes are enabled to depolarize the surface membrane, as disclosed by the arising electronegativity. The active cations concerned are those of higher dialkylamines and of alkaloids, the anions those of higher fatty acids and bile acids, the nonelectrolytes anesthetics and saponin-like compounds. All these substances are likewise significant by their cytolytic power, which is associated with a polar structure of their molecule, with surface activity and lipoidsolubility. Lytic effects frequently appear to be irreversible. But, under certain conditions, f.i. with the fatty acids by shifting the pH from a more acid to a more alkaline reaction, the depolarized state can be returned to the normal polarization.

These statements are tempting to raise the question, whether reversible cytolysis may play a role in producing the traveling negativity, the propagated reversible disturbance of the surface film of the excited fibers. Support may be lent to such an assumption by the facts that the phosphatides, characteristic constituents of the plasma membranes, are containing surface active higher fatty acids and that electric currents in passing artificial membranes, comparable to the action currents accompanying excitation, have been demonstrated to alter the ion concentrations, particularly the H ion concentrations in the electrolyte solutions bordering the membranes. Under such conditions, in the membranes various physico-chemical or chemical events could be released.

(This article is based upon a seminar report presented at the Marine Biological Laboratory on August 24).

THE GATES OF THE ANTARCTIC

Dr. R. C. Murphy

Curator of Oceanic Birds, American Museum of Natural History

The chief interest of the lecturer is in the distribution of life in the sea and the factors controlling it. For such a study Dr. Murphy has made several trips to the southern hemisphere. His lecture dealt with the waters of South Georgia, an antarctic island east of Cape Horn and of the Weddell and Ross Seas, regions recently familiar to Byrd, Wilkins and Ellsworth. Here are found numberless oceanic birds, seals and whales.

With beautifully colored slides and motion pictures, Dr. Murphy described in particular the fauna of South Georgia. The ecology, courtship, nesting habits and food of the birds were studied. The tyrant of the island is the skua, a gull-like bird, highly predacious. It is a bipolar species, existing in Iceland as well as in the far south. Its food is the eggs and young of other birds, so that the nesting habits of the latter are necessarily such as to protect them from the skua. Many gulls and terns nest upon the island. The tern, an endemic species, is similar to the famous arctic tern of the northern hemisphere. White-bellied cormorants also occur at South Georgia. Various petrels are notable for their enormous numbers. Albatrosses, with a wing spread of eleven and one half feet, have elaborate courtship habits which have evolved into community behavior. Three species of penguins, all different from those of the antarctic continent, breed at South Georgia. The gentoo penguins nest a kilometer or more from the water's edge, up the hillside. With great difficulty they climb the hills, but still they persist in placing their rookeries in such places. The king penguin incubates its single egg by balancing it on the insteps with a broad transverse fold of skin covering the egg. The third species is the crested macoroni penguin.

The largest of the seals, the sea elephant, likewise breeds on this island. It is three times the weight of the walrus and twice as long. One bull is the lord of several cows and to keep his sovereignty he fights many a wandering male. These fights are rarely mortal, but give a very bloody appearance, since the blood vessels of the palate burst, spraying blood upon each opponent.

As an end to his lecture Dr. Murphy showed a graphic motion picture of whale hunting. Whaling is a great industry at this island and more than two hundred thousand animals have already been slaughtered. Thoughtless destruction of whales is gradually being eliminated by international agreements on conservation. However, more extensive legislation is necessary, if whaling is to continue to yield marketable products for our descendents as well as for the present generation.

(This article is based upon a lecture presented at the Marine Biological Laboratory on August 18).

ON THE MECHANISM OF CELLULAR DEATH BY FREEZING

DR. BASILE J. LUYET
Professor of Biology, St. Louis University

Dead protoplasm is generally found coagulated and coagulation is often considered the essential process in the mechanism of protoplasmic death. When the lethal agents are heat, high pressure, ultra-violet radiation, mechanical injury or some of the toxic substances, coagulation is more or less simultaneous with death, but when the cells are killed by freezing, they do not show for a long time the opacity which usually characterizes the action of heat; so the question of whether or not there is any coagulation in death by freezing is a subject of controversy. Most of the colloids, inorganic and organic which coagulate by heat do not coagulate by freezing; or, if in some of them a certain turbidity is observed in the thawed fluid, it usually disappears in a short time; in other words, the process is reversible. A study, by centrifugation of the cells of the root tip of the onion killed by freezing, showed that the cellular constituents can easily be separated, while after death by several other lethal agents they can not. One would then conclude that there is no coagulation in death by freezing. But on the other hand the cells of the epidermis of the onion, in which one can follow with the ultramicroscope the changes in the optical homogeneity, show after thawing a layer of coagulated cytoplasm surrounding a still clear vacuole. The coagulum however is morphologically different from that resulting from heat. The mechanism itself of coagulation by freezing, when there is a coagulation, is probably different from that of coagulation by low temperature. The contradictory results recorded in the literature are partly due to differences in the methods and the material used in the investigations.

Some observations, perhaps of secondary interest for the problem of death are reported; for example, that the picture resulting from the distribution of ice in the frozen cells changes completely in 2 or 3 hours at 4° below zero. A cell "frozen hard" is comparatively much less stable than a moving glacier.

(This article is based on a seminar report given at the Marine Biological Laboratory on August 24).

PROGRAM OF THE GENERAL SCIENTIFIC MEETING

MARINE BIOLOGICAL LABORATORY

THURSDAY, AUGUST 26, 9:00 A. M.

Dr. B. J. Luyet and *Mr. E. L. Hodapp*: "On Some Conditions Determining Sub-cooling in Plant Tissues."

Dr. B. J. Luyet and *Sister P. M. Gehenio*: "On the Double Freezing Point of Some Living Tissues."

Dr. H. J. Curtis and *Dr. K. S. Cole*: "Transverse Electric Impedance of the Squid Giant Axon."

Dr. K. S. Cole and *Mr. J. M. Spencer*: "Electric Impedance of Unfertilized and Fertilized Arbacia Egg Suspensions."

Dr. K. S. Cole and *Dr. H. J. Curtis*: "Electric Impedance of Single Arbacia Eggs."

Dr. Samuel E. Hill: "The Effect of NaCl on Potentials in Nitella."

Dr. M. J. Kopac: "The Coalescence of a Plant Cell with Oil Drops."

Dr. Ernst Fischer: "The Influence of Length, Tension, and Tonus upon the Birefringence of Smooth Muscles (Phascolosoma and Thyone)."

Mr. Samuel A. Corson: "The Mechanism of Salt Penetration in Ameba—Some Micromanipulative Data."

Dr. Alexander Hollaender: "The Efficiency of Monochromatic Ultra-violet Radiation in the Activation of Arbacia Eggs."

Dr. B. R. Nebel, Dr. E. B. Harvey and *Dr. Alexander Hollaender*: "The cytology of Arbacia punctulata Activated by Monochromatic Ultraviolet Radiation."

Dr. Ethel Browne Harvey and *Dr. Alexander Hollaender*: "Activation of Centrifuged Whole Eggs of Arbacia and Their Fractions by Monochromatic Ultra-violet Radiation."

Mr. John A. Frank: "The Relationship of Sperm Extracts to the Fertilization Reaction in Arbacia."

Dr. L. V. Heilbrunn and *Mr. Karl M. Wilbur*: "Stimulation and Nuclear Breakdown in the Nereis Egg."

Mr. Edward L. Chambers: "The Movement of the Egg Nucleus in Relation to the Sperm Aster in Echinarachnius."

Dr. Robert Chambers: "The Physical Property of the Wall of the Furrow in a Dividing Cell."

THURSDAY, AUGUST 26, 2:30 - 5:00 P. M.

Demonstrations.

FRIDAY, AUGUST 27, 9:00 A. M.

Dr. A. Orville Dahl: "Chromosome Studies in Sundew (Drosera)."

Miss M. Catherine Hinchey: "Mitosis in the Giant Ameba, Chaos chaos Linnaeus."

Dr. A. A. Schaeffer: "Cytoplasmic Division in Type B of the Giant Ameba Chaos chaos Linnaeus."

Dr. James A. Miller: "Some Effects of Oxygen on Polarity in Tubularia crocea."

Dr. Faith Stone Miller and *Dr. James A. Miller*: "Some Effects of Strychnine Sulphate on the Regulation of Hydranth primordia in Tubularia crocea."

Dr. Horace W. Stunkard: "The Life Cycle of Moniezia expansa."

Dr. Richard G. Abell and *Dr. Eliot R. Clark*: "The Behavior of Living Mammalian Arterioles, Capillaries, and Venules When Exposed to CO_2."

Dr. Richard G. Abell and *Dr. Eliot R. Clark*: "A New Method for Studying the pH of the Intercellular Substance in the Living Mammal."

Dr. Eliot R. Clark and *Mrs. Eleanor Linton Clark*: "The Control of Peripherial Circulation in the Mammal."

Dr. Louis Loeffler: "The Structure of the Liver Lobule."

Dr. John B. Gaylor and *Dr. Ernst Scharrer*: "A Preliminary Note on the Innervation of the Swim-bladder of the Sea-robin."

Dr. W. Gardner Lynn: "The Origin and Development of the Thyroid in Eleutherodactylus, an Anuran with no Tadpole Stage."

Miss Virginia Mayo: "Some Effects of Mammalian Follicle-stimulating and Luteinizing Hormones in Adult Female Urodeles."

Dr. G. H. Parker: "The Relation of Melanophore Responses to Vascular Disturbances."

FRIDAY, AUGUST 27, 2:00 P. M.

Mr. E. P. Hiatt and *Dr. J. K. W. Ferguson*: "Some Effects of Chloroform on the Respiratory Systems of Yeast."

Dr. Jean Brachet: "The Oxygen Consumption of Activated and Fertilized Eggs of Chaetopterus."

Dr. M. E. Krahl, Miss Anna K. Keltch and *Dr. G. H. A. Clowes*: "Influence of Respiratory Inhibitors on Stimulation of Metabolism by Nitro and Halo Phenols."

Dr. G. H. A. Clowes, Dr. M. E. Krahl and *Miss Anna K. Keltch*: "Comparative Response of Certain Organisms to Substituted Phenols and Other Respiratory Stimulants and Depressants."

Miss Anna K. Keltch, Dr. M. E. Krahl and *Dr. G. H. A. Clowes*: "Stimulation of the Rate of Cell Division of Arbacia Eggs by Carcinogenic Hydrocarbons."

Dr. Albert Tyler and *Mr. N. H. Horowitz*: "The Molecular Species Concerned in the Action of Substituted Phenols on Marine Eggs."

Dr. Kurt G. Stern and *Dr. Kurt Salomon*: "Ovoverdin, a Pigment Chemically Related to Visual Purple."

Mr. Louis-Paul Dugal and *Dr. Laurence Irving*: "The Increase of CO_2 and Docalcification in Certain Pelecypods."

Mr. E. C. Black and *Dr. J. K. W. Ferguson*: "Effect of pH on the Activity of Carbonic Anhydrase."

Dr. J. K. W. Ferguson, Mr. S. M. Horvath and *Dr. J. A. Pappenheimer*: "The State of Carbon Dioxide in the Erythrocytes of Dogfish."

Dr. M. H. Jacobs and *Dr. A. K. Parpart*: "The Influence of Certain Alcohols on the Permeability of the Erythrocyte."

Dr. A. K. Parpart, Dr. M. H. Jacobs and *Mr. A. J. Dzienmian*: "Ionic Exchanges of Erythrocytes Inferred from Volume Changes."

PAPERS READ BY TITLE

Dr. L. G. Barth: "Oxygen as a Controlling Factor in the Regeneration of Tubularia."

Dr. Sinisha B. Bogdanovitch: "The Effects of Different Drugs on the Melanophores of Fundulus heteroclitus."

Dr. Sinisha B. Bogdanovitch: "Further Investigations on the Effect of Tissue on Different Drugs."

Mr. Barry Commoner: "A Quantitative Study of the Staining of Marine Eggs by Neutral Red."

Dr. Charlotte Haywood and *Dr. Abbey Turner*: "The Water and Fat Content of Skeletal Muscle in Marine Fishes."

Dr. Walter N. Hess: "Reactions to Light of Different Intensities in Dolichoglossus kowalevskyi."

Dr. Hope Hibbard: "The Hatching of the Squid."

Dr. D. L. Hopkins: "The Vacuole System of the Marine Amoeba, Flabellula mira."

Miss Lois Hutchings: "Effect of Electrical Shocks upon the Division Rate of Stylonychia pustulata as Measured by the Interdivisional Period."

Dr. M. H. Jacobs and *Mr. H. N. Glassman*: "Further Comparative Studies on the Permeability of the Erythrocyte."

Dr. J. M. Johlin: "The Attenuation of Toxins by Interfacial Adsorption."

Miss Elsa M. Keil and *Dr. F. J. M. Sichel*: "The Action of Acetylcholine on the Skeletal Muscle Fibers of the Frog."

Mr. John A. Moore: "The Effect of Pituitary on Nuclear Changes in the Egg of the Frog."

Mr. Floyd Moser: "The Effect of Urea upon the Surface of Unfertilized Arbacia punctulata Eggs."

Mr. Floyd Moser: "The Cortical Response of Arbacia punctulata Eggs to Direct Current."

Dr. Magnus Olson: "The Histology of the Retractor Muscles of Thyone briareus Lesueur."

Dr. C. Ladd Prosser and *Mr. A. H. Chambers, Jr.*: "Strength-Duration Curves of Nerve Fibers in the Squid."

Dr. Leonard P. Sayles: "New Structures Induced by Implants of Adult Nerve Cord in the Polychaete, Clymenella torquata."

Dr. Ernst Scharrer: "The Sense of Taste in the Free Fin Rays of the Sea Robin (Prionotus)."

Dr. Victor Schechter: "Calcium and Magnesium in Relation to Longevity of Mactra, Nereis and Hydroides Egg Cells."

Dr. F. J. M. Sichel and *Dr. C. Ladd Prosser*: "Temporal Relations in the Excitation of the Isolated Muscle Fibre."

Dr. H. Burr Steinbach: "Electrolytes in Phascolosoma Muscle."

Dr. Harry N. Stoudt: "Leaf Development and Vegetative Propagation in Polystichum plaschnickianum."

Dr. T. Terni: "Morphological and Experimental Cytology of Lobster Spermatozoa."

Dr. Abby H. Turner and *Dr. Charlotte Haywood*: "Observations on Arterial Pressure in Marine Fishes."

Dr. Albert Tyler, Miss Nelda Ricci and *Mr. N. H. Horowitz*: "Respiratory Rate and Length of Fertilizable Life of Unfertilized Arbacia Eggs under Sterile and Non-Sterile Conditions."

Dr. A. J. Waterman: "The Effect upon Gastrulation and Differentiation in Arbacia of $NiCl_2$, $CuCl_2$, and Na_2SiO_3 in Modified Artificial Sea Water."

Dr. Ralph Wichterman: "Studies on Living Conjugants of Paramecium caudatum."

Dr. Ralph Wichterman: "Conjugation in Paramecium trichium Stokes (Protozoa, Ciliata) with Special Reference to the Nuclear Phenomena."

Dr. Opal M. Wolf: "Mitotic Activity of Stimulated Rat Adrenals Measured by Colchicine Technique."

DEMONSTRATIONS

Dr. S. E. Pond and *Mr. L. F. Boss*: "Sources of Working Current for a Potentiometer."

R. Chambers and *B. W. Zweifach*: "Micro-manipulative Studies of Blood Capillaries." (Motion pictures).

Dr. J. E. Kindred: "Stages in the Development of Lymph Nodules."

Dr. E. A. Wolf: "Individual Variations in Salivary Amylase in Man."

Dr. K. S. Cole, Dr. H. J. Curtis and *Mr. J. M. Spencer*: "Alternating Current Wheatstone Bridge for Impedance Measurements at Frequencies from 30 to 10,000,000 Cycles."

Dr. E. R. Clark and *Mrs. Eleanor L. Clark*: "Control of the Peripheral Circulation as Seen in the Living Mammal."

Dr. R. G. Abell and *Dr. E. R. Clark*: "A New Method for Studying the pH of the Intercellular Substance in the Living Mammal."

Dr. V. Hamburger: "Limb-bud Transplantation in Chick Embryos."

Mr. J. A. Smith: "Types of Hermaphroditism in Mollusca."

Dr. F. O. Schmitt and *Dr. O. H. Schmitt*: "A Convenient Method for the Measurement of Nerve Respiration."

Dr. F. O. Schmitt, Dr. O. H. Schmitt and *Dr. R. S. Bear*: "Action Potentials from the Giant Axon of the Squid, Loligo pealii."

Dr. S. E. Hill: "Action Currents in Nitella."

Dr. J. B. Gaylor: "Innervation of the Swimbladder of the Sea-robin."

Dr. E. Fischer: "Volume Changes of Muscle on Contraction."

Dr. C. E. McClung: "Relation of the Apical Cell to the Germ Cell in the Grasshopper Testis."

Dr. H. Irené Corey: "Polar Elements of Orthopteran Chromosomes."

Dr. D. H. Wenrich: "Mitosis in Dientamoeba fragilis."

Dr. C. L. Parmenter: (a) "Haploid, Diploid, and Triploid Mitosis in Parthenogenetic Frog Tadpoles." (b) "Mono, Di, Tri, and Tetra-nucleate Blood Cells in Haploid Parthenogenetic Frog Tadpoles."

Dr. A. A. Schaeffer: "Types A and B of Chaos chaos Linnaeus, the Large Multinucleate Ameba of Roesel."

Dr. A. K. Parpart: (a) "Method for the Rapid and Complete Separation of Erythrocytes from a Surrounding Medium." (b) "Volume Changes of Erythrocytes Produced by an Ionic Exchange."

Dr. G. Failla: "New x-ray equipment of the Marine Biological Laboratory."

Dr. T. Terni: (a) "Morphological and Experimental Cytology of Lobster Spermatozoa." (b) "The Nervous System of Dogfish Embryos."

Mr. L. F. Boss and *Dr. S. E. Pond*: "Combination Thermostat, Heat Interchanger and Relay Unit for Constant Temperature Bath."

Mr. C. G. Grand: "Cytolytic Effects on Marine Eggs after Puncturing with Micro-needles."

Dr. M. J. Kopac: (a) "Living Valonia Aplanospores." (b) "Apparatus for Delivering Oil Drops under Constant Pressure."

Dr. Eleanor Carothers: (a) "Development of Mid-gut of Melanoplus differentialis." (b) "Effects of x-rays on Grasshopper Embryos."

Dr. A. Hollaender: "Equipment for Work with Measured Quantities of Monochromatic Radiation in the Visible and Ultra-violet."

Mr. L. F. Boss, Dr. A. Hollaender and *Dr. S. E. Pond*: "Inexpensive 500 Volt D.C. Power-supply for High Intensity Ultra-violet."

Dr. B. R. Nebel and *Dr. E. B. Harvey*: "Cytological Observations on Arbacia Eggs Activated by Monochromatic Ultra-violet Radiation."

Dr. L. Loeffler: "Injected Liver of Toadfish."

Dr. R. W. Root and *Dr. W. Etkin*: "Use of the Constant Flow Method for Serial Determinations of Oxygen Consumption in Toadfish."

DROSOPHILA INDUCED BY SUBLETHAL MUTATIONS AND MODIFICATIONS IN HIGH TEMPERATURE

Professor Harold H. Plough and Philip T. Ives
Department of Biology, Amherst College

During the past four years a series of interesting results of treatment of Drosophila larvae and pupae with high temperature (36.5°C.) for brief periods has been reported by Dr. V. Jollos. The chief effects reported are:—(1) an increase in the total number of mutations, (2) the appearance of a small number of "specific" mutations with great frequency under special culture conditions, (3) the finding of Dauermodifikationen, or lasting modifications, which are transmitted through the female line for several generations, (4) the production by treatment in successive generations of a step-by-step series of more extreme allelomorphs of certain genes, which are thought to give experimental basis for orthogenetic evolution. These results were so far at variance with the experience of other Drosophila workers that three years ago we began an independent series of tests using identical methods in order if possible to gather data for an independent judgment. This was especially desirable since Dr. Jollos has not been able to publish his complete quantitative data, so that it could be independently evaluated by other investigators.

Our experimental lines have now mounted up to a total of about 250,000 heated flies and their offspring for eight generations, and 100,000 controls from the same series. In all we have isolated and identified from offspring of heated flies 44 mutations of all classes, and only 3 from the controls examined with the same care. A preliminary statement of our results was given in a recent publication (*Proc. Nat. Acad. Sciences*, May 1934) and the complete account is in press in *Genetics*. I may summarize our chief conclusions for comparison with those of Jollos. (1) Brief exposures of larvae to sub-lethal high temperature causes a six-fold increase in the number of mutations. (2) A parallel increase in the number of modifications (non-inherited variations) was noted, but no Dauermodifikationen were found. (3) There is evidence from recurrent mutations that certain genes mutate more frequently than others, but no indication of step-by-step or "directed" mutations. (4) The chief importance for evolutionary theory would seem to be that temperature variation in nature is one causal factor in maintaining a definite mutation rate.

There are certain unexpected results in our experiments which have had only brief mention and which have not been noted by Dr. Jollos. These are shown by examining the mode of appearance of the true mutations and the modifications appearing in the generations following treatment. Since every fly which showed any variation whatever was isolated, mated, and the offspring bred for at least two generations, we have very exact data for this purpose. When both male and female parents were heated we found among the offspring twice as many mutations as when one only—either male or female—was the heated parent. The rates are low but the differences from the controls appear to be significant. If we now turn to the modifications we find that the number—ten times greater than the mutations—among the offspring of treated females and two treated parents is the same, while if the male alone is treated, no increase over the control appears. Thus modifications are produced by treatment of the female parent but not by heating the male. These differences in the results appear to prove that high temperature acts directly on the genes in either female or male germ cells producing mutations, and on the cytoplasm (of which little is present in the sperm) producing modifications.

A still more interesting result revealed by our data is the apparent delayed appearance of both mutations and modifications. Classification of the 43 mutations identified, by generation after treatment, shows that 8 appeared in the second generation, 20 in the third, 7 in the fourth, and 8 in the fifth. Separating these into classes—X linked lethals, X linked visible recessives, autosomal recessives, and dominants—it is possible to say with certainty that 14—or 33%—could not have occurred at the time of heating. Yet this 33% represents an apparently significant increase over the control. With respect to the modifications much the same situation is found. The non-inherited variations are nearly three times more numerous than the controls in the second generation from heated females, and an excess shows as far as the fifth generation after treatment. The most probable conclusion from this part of the work at its present stage is that the heat produces changes in both genes and cytoplasm. These changes may result in mutations and modifications at once, or the effect of the change may be delayed for many cell generations before reaching a new equilibrium.

(This article is based on a seminar report presented at the Marine Biological Laboratory on August 21, 1936).

KILLING ORGANISMS WITH CHROMIUM AS FROM INCOMPLETELY WASHED BICHROMATE-SULFURIC CLEANED GLASSWARE

Dr. Oscar W. Richards
Instructor in Biology, Yale University

Potassium bichromate is an important component of many of the killing and fixing fluids of the biologist as well as of the bichromate-sulfuric acid mixture often used for cleaning glassware. Because the bichromate adsorbs to glassware and is washed out with difficulty it is necessary to question the danger involved when this mixture is used to clean glassware intended for use with living organisms.

Laug[1] has found that s-diphenylcarbohydrazide may be used to determine colorimetrically as little as one tenth microgram ($\mu g. = 10^{-6}$ gram) of potassium bichromate per milliliter of solution. Different kinds of glassware were immersed in cleaning fluid for various times and then washed with seven changes of tap water and three of distilled water. After this washing Laug extracted the remaining bichromate and determined the amount left on the glassware. From his measurements it would be possible with small amounts of solution to reach concentrations of bichromate of the order of 0.1 to 1.0 μg./ml.

These concentrations of potassium bichromate reduce the growth of a yeast population from 22 to 47 per cent. within 24 hours after seeding and prevent complete recovery of the population.

Knop's solution containing 0.1 μg./ml. bichromate caused the killing and blackening of about one quarter of the filaments of two species of Spirogyra placed in it. The bichromate is bound by the injured filaments and its concentration in the solution is reduced. Recovery of the Spirogyra was then possible and was nearly complete by 15 days. With 1.0 μg./ml. only half of the filaments recovered in the same time. The blue-green alga *Oscillatoria limosa* showed less injury within 24 hours, but recovery was less complete as compared to the control cultures in 15 days. The diatoms and desmids tested were less sensitive to the poison but Raphidium was killed in 1.0 μg./ml. bichromate to a sufficient extent to preclude its use as a test organism under these conditions.

When the culture fluids are alkaline less bichromate will remain in solution and this is true also for sea water. Concentrations of 10 μg./ml. and greater were toxic for developing Arbacea eggs in experiments made by Mrs. E. N. Harvey. Until the toxicity of bichromate to other marine organisms is known care should be taken to avoid the possibility of bichromate contamination from inadequate washing of glassware previously cleaned by the sulfuric acid-bichromate mixture.

The developing *Ambylstoma punctatum* egg was the most sensitive material tested. Only one half of the hatched tadpoles were normal when the concentration of bichromate was 0.0001 μg./ml. With greater concentrations no normal tadpoles occurred. The bichromate penetrates from a weak solution into the capsule and the injury is greatest at first. The closure of the neural folds is incomplete and yolk material is extruded. When a concentration of 0.5 μg./ml. was reached the capsule is hardened and penetration of bichromate is delayed and the injury occurred later at, or just after, hatching. The mortality at this concentration was 80 per cent. while none of the controls died. One μg./ml. hardened the capsule, delayed hatching, produced kyphotic animals with hypersecretion of mucus and reduced gills. These amounts of bichromate might occur when glassware was cleaned in cleaning solution and only washed ten times. Further details of the experiments will be published elsewhere.

Small nearly closed microrespiration vessels (Warburg, etc.) and other forms of dish that are hard to wash should receive especial attention to prevent traces of bichromate remaining that would influence living organisms. Laug recommends successive periods of at least 15 minutes in boiling water to remove the bichromate. Hot water is three times more efficient in removing the bichromate than is cold water.

Unless it is known that the washing is sufficiently complete or that the organisms used are not affected by the amount of bichromate remaining it would seem better to avoid the use of the sulfuric acid-potassium bichromate mixture. Ten per cent. nitric acid is a good cleaning mixture and its components are volatile. Another good cleaning fluid is 1 - 5 per cent. trisodium phosphate. The use of a brush and a good soap, such as Sapolio, will give a clean surface on most dishes that will take an even film of water. Pipettes and other vessels too small for a brush may be cleaned with the less toxic compounds.

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[1] Laug, E. P., **Jour. Ind. & Eng. Chem., Anal. Ed.**, 1934, 6:111-112.

THE EFFECT OF SOME OXIDATION-REDUCTION INDICATOR DYES (PHENOL INDOPHENOL) ON THE EYES AND PIGMENTATION OF NORMAL AND HYPOPHYSECTOMIZED AMPHIBIANS

Dr. Frank H. J. Figge

Associate Professor of Anatomy, University of Maryland Medical School, Baltimore, Md.

In a series of experiments between 1926 and 1929, Margaret R. Lewis and Warren H. Lewis demonstrated that certain dyes inhibited the activity of tumor-producing substances. In 1929, Jessica Lewis attempted to determine the effect of these dyes on the growth rate of *Rana sylvatica* eggs. She found that the dyes had no apparent effect on growth or differentiation, but the tadpoles that had been raised in solutions of indophenol dyes exhibited a marked pallor of the skin and loss of the pigmented layer of the optic cup.

The discovery of the remarkable effect of these dyes was regarded as a new key to some of the secrets of the biology and biochemistry of pigment formation. This is a report on a few of the preliminary steps that have been taken to use this discovery to add a few more facts to our knowledge in this most fascinating field. In addition, it was hoped that the dyes could be used to produce pigment-free animals which would facilitate making direct observations on blood vessels and nerves in living salamanders.

In 1933, I found that the dyes were not quite as effective in producing loss of pigment in *Amblystoma punctatum* as they were in Rana pipiens. In 1935, phenol indophenol and orthocresol indophenol were tested on a series of six different kinds of amphibian eggs in an attempt to gain some understanding of the mechanism of action of the dyes. The dyes were tested on normal and hypophysectomized *Amblystoma punctatum*, black and white Mexican axolotl, Necturi, and bullfrog eggs. The hypophysectomies were performed between the Harrison stages 30-37. The animals were placed in the dye solutions shortly after this, or near the hatching stages and kept there continuously for a period of three months. In the beginning, two concentrations of each dye were used: 1:500,000 and 1:1,000,000. As the animals grew, it was necessary to increase the concentrations. Dye solutions were changed daily, and during the last half of the experiment, twice daily.

From a study of the relative sensitivity of the salamanders to the dye, it was evident that the degree of sensitivity paralleled the metabolic rate. The higher the metabolic rate, the less sensitive the animal, and less effective the dye.

In my 1933 experiments, it was noted that the pallor produced by some of the dyes in salamander larvae bore a striking resemblance to the pallor produced by hypophysectomy. It was thought that the dye might possibly be producing its effect by some action on the hypophysis. In hypophysectomized *Amblystoma punctatum* larvae, the melanophores in the margin of the tail fins contain considerable melanin which is widely dispersed so that the margin of the tip of the tail appears black. The dyes eliminated the pigment from the tails of these animals proving conclusively that the dyes do not exert their influence on the melanophores through any intermediate effect on the hypophysis or its products.

To test the possibility that there might be a relationship between the rate of decolorization of the dyes and the tendency to form pigment, the eggs of black and white axolotl were placed in dye solutions. It was supposed that if the rate of decolorization of the dyes depended on the rate of pigment destruction or elimination that the dyes would not be decolorized as rapidly by the white axolotl. They decolorized the dyes, however, as rapidly as the black axolotl. The rate of decolorization of the dye was, therefore, not related to the rate of pigment destruction.

The dyes were tested in Necturus, because Necturus resembles certain cave salamanders that exhibit eye and pigment defects not unlike those produced by the indophenol dyes. With Necturus, concentrations 1/5 as strong were necessary because of the toxicity. Even in these relatively weak solutions, the dye was more effective in eliminating the pigment in Necturus than in any other type of larvae tested.

Mrs. Lewis described the eye defects produced by these dyes in tadpoles as a loss of the pigmented layer and a collapse or folding of the retina. Due perhaps to more prolonged and intensive treatment of the more susceptible Mexican axolotl, greater eye defects resulted. These defects involve not only the retina and the pigmented layer of the eye, but also the scleral cartilage, lens and cornea. The cells comprising these structures seem to lose their polarity or are unable to orient themselves in the usual way. There is no uniformity in the susceptibility of the eyes to dye effects. Even in the same animal, one eye may show more marked changes than the other. Extremely defective eyes resulting from treatment with indophenol dyes have been observed only in tadpoles and Mexican axolotl. The eyes of *Amblystoma punctatum* seem to be much less sensitive to the dyes.

(This article is based upon a seminar report presented at the Marine Biological Laboratory on August 11, 1936).

The Collecting Net

A weekly publication devoted to the scientific work at marine biological laboratories

Edited by Ware Cattell with the assistance of Anna-Betty Clark, A. S. Cattell, Garnette McClure and Boris Gorokhoff.

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IDLEDAY SCHOLARSHIP CARNIVAL

A Carnival exceeding in magnitude and variety any that has ever been held on the Cape will take place on Labor Day in Woods Hole for the benefit of The Collecting Net Scholarship Fund and The Woods Hole Log Scholarship Association. Although there will be preliminary dances and a banquet, the main events will take place on Labor Day when an elaborate fair will be erected in the Woods Hole baseball park. Besides the booths and other features of the Midway, there will be street dancing, a beauty contest, baseball games, concerts, performances by local talent, auctions, and numerous other attractions.

The Idleday Scholarship Carnival, as it has been named, is being staged for the benefit of the two scholarship funds by a group of individuals who believe in the purpose of these organizations, the education of young people, both in collegiate and research lines. The work of these two funds is too well known for repetition. Thousands of dollars of scholarships have been provided not only for investigators at the Marine Biological Laboratory, but also for deserving residents of Woods Hole to assist them in carrying on their education.

Meetings have already been held of the persons interested in the affair and the work of organization is under way. Anyone who is interested in furthering the success of the carnival is invited to assist. Volunteers for any phases of the production will find their ideas and talents welcome. Offices have been set up in the Community Hall in Woods Hole to form headquarters for the committees working for the Carnival. Any who wish to help are invited to call there.

Another form of assistance is open to those who are able to do so. Stock in the carnival is for sale at $10.00 a share. Financial success will result in the refund of the amount plus 50c per share. Losses, if any, will be borne by the shareholders. Many people of course cannot undertake to invest a full ten dollars, but if they wish to support this charitable undertaking they can do so by purchasing a share in groups of five or ten.

Introducing

Imre Törö, private docent in the Anatomical Institute of the University of Debreczen, Hungary; and Rockefeller fellow at Columbia University.

Dr. Törö was born in 1900 in Debreczen, Hungary. He attended the University of Budapest and received his M.D. from the University of Debreczen, where he is now teaching histology, embryology and gross anatomy.

In 1929-30 a fellowship from the government made it possible for him to work with Dr. Mangold at the Kaiser Wilhelm Institut für Biologie in Berlin. There he conducted experiments in histology and embryology. In histology he worked on intestine resorption, heart muscle regeneration and on the transformation of the cell potentialities in tissue culture. His experiments in the field of embryology were on lens regeneration.

In September 1936 he came to Columbia University as a Rockefeller fellow in the department of anatomy, where he worked on medullary plate induction in mammalian embryos.

In Woods Hole Dr. Törö is working on two problems; the mechanical influence in the gastrulation of sand dollar eggs and on lens regeneration in fundulus embryos.

In September he will return to Columbia where he will remain until Christmas when he plans to return to Hungary.

August 6, 1937.

To The Editor:

It is a pernicious tradition that the Nominating Committee of the M. B. L. Corporation automatically renominate all of the eligible Trustees whose previous terms have expired. At present a Trustee must die, become emeritus, or be absent for two years before a vacancy occurs. In the latter case the Trustees have it over the U. S. Supreme Court, but strong sentiment favors renomination of the prodigal. As matters now stand the five members of the Nominating Committee really appoint for life as many Trustees as there are vacancies, caused by death or graduation. It is true that the appointments are nominally for a term of four years, but a study of the record will show that actually it is for life.

There is, of course, something to be said for the renomination of experienced Trustees. However, it is entirely possible (even probable) that among the Corporation membership there are others who would represent adequate geographical distribution; advertising qualities; active and fundamental research; and who would have the interests of the Marine Biological Laboratory at heart to an even greater extent than some of those who appear annually only at the time of the Lobster dinner.

The nomination of Dr. Armstrong is highly to be commended. The other seven re-nominations may be the best possible. Nomination seems to mean election and the tradition of automatic re-nomination alone is called into question.

Sincerely,

CORPORATION MEMBER

ITEMS OF INTEREST

PRESENTATION OF THE YALDEN SUNDIAL

The Yalden Sundial, which has been the subject of much comment on the waterfront this summer, was formally presented last Monday to the Marine Biological Laboratory. Dr. Harold C. Bradley, representing Mr. Charles R. Crane, the donor, who was absent on account of illness, gave a speech donating the sundial to the Laboratory. Dr. Edwin G. Conklin accepted the gift for the Laboratory, while Dr. Frank R. Lillie presided.

The ceremonies were to have been held outdoors, but owing to rain they were held in the M. B. L. auditorium. The audience, some of whom came dressed in oilskins prepared for outdoor exercises, was composed of trustees and invited guests.

Dr. Lillie, in opening the ceremonies, spoke briefly of J. Ernest G. Yalden, the designer of the sundial, who died in February soon after he had completed his part of the project.

Dr. Bradley explained how the sundial came to be built. A grandson of Mr. Crane had become interested in astronomy and in furthering this interest Mr. Crane had become acquainted with Professor Yalden. As a result of this friendship the idea for constructing a sundial was developed.

In closing his remarks, Dr. Bradley said: "Mr. Crane said to me last night—'I wanted to have here a souvenir of Professor Yalden—something that would give us a glimpse into the marvelous precision of his mind and a reminder of his happy spirit—his interest and love for Woods Hole.' I should like to add to this statement. In tendering this monument to the Laboratory in behalf of Mr. Crane, I shall always think of it as a souvenir of these two men in happy collaboration—a reminder of the warm friendship of which it is in fact the fruition;—a symbol of their mutual regard and love for this community of scientific workers which constitutes the Marine Biological Laboratory."

Dr. Conklin, in accepting the Sundial, briefly reviewed the interests of Professor Yalden and then described the Sundial.

M. B. L. CLUB NOTES

On Thursday evening, August 26, Mr. Ralph M. Pearson spoke in the Community Hall on "Modern Art and Its Meaning to the Community." This lecture was one of a series which the M. B. L. Club is sponsoring so that it may at least in part repay the Marine Biological Laboratory the cost of reroofing the clubhouse. On Wednesday evening September 1 the Club is sponsoring a lecture to be given by Theodor Dreiser.

On Monday, August 30 the Club will hold its usual phonograph concert. The program includes: The Triangle Concerto (for the piano) by Liszt, Franck's Variations Symphonique and Brahms' Symphony Number 4.

At the meeting of the board of trustees of the Marine Biological Laboratory held on Tuesday, August 10, unanimous approval was given to the enclosed expression of appreciation of Dr. Jacobs' services to the Laboratory.

"The Trustees have learned with great regret that Dr. Merkel H. Jacobs finds it necessary to resign from the Directorship of the Marine Biological Laboratory after twelve years of service in that position. His eminence as investigator and teacher has been reflected in the high standards in research and instruction which he has maintained in this Laboratory. His fidelity to all the details of administration, his unselfish cooperation with all who have needed his assistance, his good judgment and equanimity in important and often trying circumstances have never failed and the results are shown in the splendid record of the Laboratory during his administration. We recognize the reasonableness of his request to be relieved now of these obligations in order to devote his time more fully to his research and we are assured of his continued interest in the Laboratory and devotion to its welfare."

Dr. and Mrs. Thomas B. Grave have been visiting Professor and Mrs. Caswell Grave in their home on High Street, Woods Hole. They arrived on August 22 and plan to stay until after Labor Day. Dr. Thomas Grave is one of the few who have rowed from Woods Hole to New York in an open row boat.

Woods Hole is rejoicing that Professor Robert Chambers, Zoya Zarudny and Jennie Massaro have returned from their extended visits to the Cape Cod Hospital.

Miss Anna Betty Clark, who received her M. A. degree in zoology last June from Columbia University has been given an assistantship in zoology at Manhattenville College.

CURRENTS IN THE HOLE

At the following hours (Daylight Saving Time) the current in the Hole turns to run from Buzzards Bay to Vineyard Sound:

Date	A. M.	P. M.
August 29	10:33	11:19
August 30	11:39	
August 31	12:23	12:44
September 1	1:26	1:47
September 2	2:29	2:41
September 3	3:24	3:37
September 4	4:15	4:26

In each case the current changes approximately six hours later and runs from the Sound to the Bay.

NOTES AND NEWS FROM M. B. L. CLASSES

BOTANY CLASS NOTES

And so time flies. From brown algae the trend of study has turned to red, (Rhodophyceae). Although this is not a course in artistic appreciation, still we have to stop to admire our algae problems from the esthetic point of view. Turning the high power on these elaborate forms we are still greater admirers of the morphological beauty we behold. However, for pure observation the delicate art of sectioning must be acquired. A cross section of a fingernail is not infrequently added to the transverse view of the axis of the plant.

We have taken to the waves for our field trips. If the algae can brave the surf so can we and so we did. Although the rudder broke delaying us on our rough course we arrived at Penikese last Thursday before the change of tide. A picture of the class sitting on the rocks grabbing at fragments borne in by the tide would be a choice addition to *Life*. Beach-combers would hardly cover the subject. Three-thirty the next morning saw the last weary members of the class leaving their cherished mounts for the press. We are all approaching the sixty-fifth mark in the collection scale with one hundred specimens as our goal.

This week we pray for calm weather for a-dredging we shall go. The weather shall say whether we shall get sea-sick or no. An all day trip aboard the *Nereis* shall be our test. If the test is successful the lights will be burning bright in the late evening and so our collection shall increase in bulk.

And so now back to cross sectioning with one eye on a rusty razor blade and the other turned in search of a slight break in the sky.—*J. P. H.*

INVERTEBRATE CLASS NOTES

The gods that have hitherto smiled benevolently on the Invertebrate class of 1937 have failed to break the North Falmouth jinx. For the last five years the trip planned to that locality has been cancelled due to bad weather. Before this our luck held in full force for three all day field trips.

It was a week of firsts. The Lagoon Pond Bridge trip gave us our first glimpse of Martha's Vineyard and the Hadley Harbor trip, our first experience with real mud. On the way to Cuttyhunk, we had our first taste of open sea. It was also a week characterized by the finding of several forms not seen for several years and the exhibition of the forms collected at Hadley Harbor on the tables in the main laboratory.

All felt the urge to applaud Dr. Hadley's Wednesday lecture on marine biology but were eager to follow Dr. Matthew's soothing voice explain how lateral torsion and ventral flexure change the misguided snail's morphological left to his topographical right.

We also had our troubles doing in the three assigned hours the thirty hour or so dissection of Busycon, but midnight snacks with coffee and tea served in finger bowls helped out considerably. Cumingia, although elaborate precautions were observed, simply failed to do the expected the first day, but on the second, under Dr. Matthew's watchful eye and a policy of all other hands off, it produced eggs and lively embryos in the afternoon which promptly died during the dinner hour before many had a chance to observe them.

Those fortunate ones on the *Nereis* Saturday had a taste not only of spray, but of real boat racing when the two *Endeavors*, the *Yankee* and the *Ranger* were seen under full sail. The staunch little *Nereis* followed the racers for over half an hour and was for some time within a few hundred yards of the *Yankee* and one of the *Endeavor*.

The surface nervous system of Ensis, the razor-shell clam; the azure eyes of Pecten, the constantly varying colors of Loligo, the squid, and the midafternoon consumption of the sandwiches prepared for the postponed field trip all served to keep the laboratory full of jovial and interested invertebrates all through this week.

MACHINE TO RESTORE LIFE!

Special Cable to The New York Times, July 12, 1937

London, Sunday, July 11.—Colonel Charles A. Lindbergh and Dr. Alexis Carrel have gone beyond their "artificial heart" and have designed machines to test Dr. Carrel's theory that the life of living organs may be restored, The Sunday Express said today.

In an article purporting to explain Colonel Lindbergh's secret visit to Dr. Carrel on a lonely island off Brittany last week, the newspaper said that the flier needed to fit one of the most important parts of the new machine.

Dr. Carrel will use the machine, it went on, to take various living organs such as glands, kill them by drying them and then bring them back to life. The scientist hopes a secret process will permit him to restore organs any time he chooses in exactly the same state as when they were taken from the body, it was declared.

"The main development of this experiment, if it succeeds," The Sunday Express said, "may mean that an animal that has been apparently dead for years can be brought back to life in exactly the same condition as it was when life was suspended—no older and in perfect health."

Recalling that Dr. Carrel has previously predicted that in the future human beings may have animation suspended at any period they desire and then return to life, the article said that an improved model of the artificial heart, enabling him to keep alive a brain removed from an animal, formed part of the new machine.

DEPARTMENT OF PUBLICATIONS

AN INTRODUCTION TO COMPARATIVE BIOCHEMISTRY. By Ernest Baldwin. With a foreword by Professor Sir F. Gowland Hopkins. Pages xviii and 112. The Macmillan Company and Cambridge University Press. 1937. Price $1.50.

The reviewer has found this little book very interesting and stimulating and he feels sure that students of biochemistry, physiology and zoology will do well to read it. For it lays clearly before one what the author believes to be the problems which organisms had to face when confronted with the necessity of adapting themselves to new environments, such for example as passing from water to land, or from sea to fresh water or the reverse, or from swamp to arid conditions; the way in which it appears that the problem was solved.

Chapter I, for example, deals with the colonization of fresh water and the ionic composition of the blood of sea and fresh water animals: Chapter II, with the way osmotic independence was attained: Chapter III, with the colonization of dry land. The other chapters consider the various forms of nitrogen metabolism characteristic of different types of animals; respiratory pigments and respiratory catalysts. All this makes a very attractive lot of questions, problems and facts.

The foreword by Professor Hopkins expresses in pleasant terms, characteristic of the man, some of the main problems of biochemistry as yet but little investigated which are pressing for solution before the problems of development, inheritance and evolution can be understood. These problems are not considered in the usual medical courses of biochemistry owing to the pressure of the more purely utilitarian and medical aspects of the subject and the brief time possible to devote to biochemistry in the medical curriculum of today.

In the Preface the Author explains that he has sought not to present a thorough treatment of the general subject of comparative biochemistry but to stimulate the interest of students by presenting to them certain few selected aspects of the problem.

It is a reproach to our universities that the great subject of biochemistry has received so little and such half hearted support. It argues a colossal stupidity on the part of the leaders of medical education that so small a proportion of the time of the medical curriculum is devoted to the subject. The fact of the matter is that the chemical resemblances and differences of various species of animals and plants are just as important, or even more important, than anatomical differences. No real understanding of the mechanisms of inheritance and evolution will be possible until the chemical resemblances and differences are known. If this book will stimulate interest in this most important and almost wholly neglected field, as it will help to do, it will have fulfilled a very important function.

The reviewer believes that a more objective and less teleological handling of the material would be advantageous for a scientific presentation, although the teleological no doubt will be more interesting for the general reader and may indeed in the long run prove to be the more correct. The materials are presented in the first half of the book as problems which animals had to solve in order to survive in new environments. We know so little of the real course of evolution in any one form and the circumstances which led to that evolution that we cannot be sure that these were the particular problems, the solution of which led to some modification of integument, or kidney, or nitrogen excretion which we find in the animals at present inhabiting that environment. For that reason it appears to the reviewer that a more objective description of things as they now are would be scientifically more accurate and in the long run far more satisfactory to the author.

There are one or two comments which might be made and which are omitted concerning the composition of sea water. For example it has seemed to the reviewer that in the glacial epochs, with the water distilled and condensed as ice on the land so that the level of the sea was several thousand feet below its present level, there must have been a great concentration of salt in the sea water remaining. Also when the glaciers were melting and our rivers many times their present size there must have been violent changes in osmotic properties in the mouths of these rivers and surrounding oceans. At the arctic and antarctic the melting of the ice, which must have deplaced much sea water at the poles, must have made brackish water at the poles.

On page 21 it is stated that the laws of osmosis require that water shall pass from the weaker to the stronger of two solutions. Of course scientific laws require nothing at all. They are simply statements of generalizations and while the author knows this perfectly well, it would be better to avoid expressions which seem to imply that natural laws have some power of action or control. On page 35 it is implied that the kidney is the main method of removing ammonia from the blood. On the same page it is stated that the evolution of a large and complex brain was precluded in the insects 'for reasons of space,' but not in the vertebrates. The reviewer can see no reason why it was more 'precluded' in the one case than in the other. There is an amusing slip of the pen, although the meaning is quite clear, in the statement 'that a given blood will be efficient if it reacts reversibly with oxygen and the *n* of

Hill's equation is greater than unity,' etc. We shudder to think how inefficient it would have been if Hill had not lived and the *n* a zero!

But it is impossible to write a book without errors, as the reviewer knows from hard experience and these little slips do not affect the real value of the book. Perhaps they enhance that value, for it is always pleasant to discover that others, as well as one self, can make mistakes. It gives one a friendly feeling for the author.

The reviewer heartily recommends the book as informative within its limits, stimulative and most interesting; these are qualities good books have. —*Albert P. Mathews*

SOME BOOKS IN BIOLOGY PUBLISHED BETWEEN SEPT. 1, 1936 - SEPT. 1, 1937

Baldwin, E. Introduction to Comparative Biochemistry. (1937) Macmillan. $1.50.

Barnes, T. C. Textbook of General Physiology. (July 1937) Blakiston. $4.50.

Barnhart, P. S. Marine Fishes of Southern California. (1936) California. $4.00.

Best, C. H. and Taylor, N. B. Physiological Basis of Medical Practice. (Jan. 1937) Wood. $10.00.

Bose, Life Movements in Plants. Longmans, Green. $7.20.

Boyd, W. An Introduction to Medical Science. (1937) Lea & Febiger. $3.50.

Bremer, J. L. Textbook of Histology. 5th ed. (July 1936) Blakiston. $6.50.

Cajal, Ramony. Recollections of My Life. trans. E. H. Craigie. (1937) Pennsylvania. $5.00.

Cannon, W. B. and Rosenbluth, A. Autonomic Neuro-Effector Systems. (1937) Macmillan. $4.00.

Curran, C. H. & Kauffeld, C. Snakes and Their Ways. (1937) Harper. $3.50.

Darlington, C. D. Recent Advances in Cytology. 2nd ed. (March 1937) Blakiston. $6.00.

Davison, A. Mammalian Anatomy. 6th ed. (Feb. 1937) Blakiston. $3.00.

Detwiler, S. R. Neuroembryology, an Experimental Study. (1936) $3.75.

Ditmars, R. L. The Reptiles of North America. (1936) Doubleday, Doran. $6.75.

Downing, E. R. and McAtee, V. M. A Learning Guide in Biology. (1937) Lyons & Carnahan. 92c.

Erlanger, J. and Gasser, H. S. Electrical Signs of Nervous Activity. (Dec. 1936) Pennsylvania. $3.50.

Fieser, L. F. The Chemistry of Natural Products related to the Phenanthrenes. 2nd ed. (1937) Reinhold. $7.00.

Frobisher, M., Jr. Fundamentals of Bacteriology. (Jan. 1937) Saunders. $3.25.

Fuertes, L. A. and Osgood, W. H. Artist and Naturalist in Ethiopia. (1936) Doubleday, Doran. $5.00.

Guyer, M. F. Animal Biology. (1937) Harper. $3.75.

Hauber, U. A. and O'Hanlon, M. E. Biology. (1937) Crofts. $3.90.

Heilbrunn, L. V. Outlines of General Physiology. (July 1937) Saunders. $5.00.

Hentschel, A. J. and Cook. Biology for Medical Students. (July 1937) Longmans, Green.

Hesse, R. Ecological Animal Geography. trans. Alle & Schmidt. (1937) Wiley. $6.00.

Hill, C. Manual of Normal Histology and Organology. (Jan. 1937) Saunders. $3.50.

Hill, A. F. Economic Botany. (1937) McGraw-Hill. $4.00.

Holmes, E. G. Metabolism of Living Tissues. (1937) Macmillan. $2.50.

Holmes, S. J. General Biology. rev. ed. (May 1937) Harcourt, Brace. $3.50.

Kahn, R. L. Tissue Immunity. (1936) Thomas. $7.50.

Kenoyer, L. A. and Goddard, H. General Biology. (1937) Harper. $3.50.

Kopaczewski, W. Traité de Biocolloidologie. (1937) Gauthiers-Villiers.

Kuntz, A. A Textbook of Neuro-Anatomy. (1936) Lea & Febiger. $6.00.

Landsteiner, K. The Specificity of Serological Reactions. (1936) Thomas. $4.00.

Lindsey, A. W. The Science of Animal Life. (Jan. 1937) Harcourt, Brace. $3.75.

Little, M. E. Structure of the Vertebrates (May 1937) Farrar & Rinehart. $3.00.

Loomis, W. E. and Shull, C. A. Methods in Plant Physiology. (1937) McGraw-Hill. $4.50.

Mayer, J. The Seven Seals of Science. (1937) Appleton-Century. $3.00.

Miall, Chemistry, Matter and Life. (July 1937) Longmans, Green.

Page, I. H. Chemistry of the Brain. Thomas.

Parker, G. H. Color Changes in Animals in Relation to Nervous Activity. (1936) Pennsylvania. $1.50.

Pincus, G. The Eggs of Mammals. (1936) Macmillan. $3.75.

Robbins, W. W. and Ramaley, F. Plants Useful to Man. (May 1937) Blakiston's. $3.50.

Shyrock, R. H. The Development of Modern Medicine. (Nov. 1936) Pennsylvania. $4.00.

Sloan, E. P. The Thyroid. (1936) Thomas. $10.00.

Stanford, E. E. General and Economics Botany. (1937) Appleton-Century. $4.00.

Starling's Principles of Human Physiology. rev. by C. L. Evans. 7th ed. (1936) Lea & Febiger. $8.75.

Thompson, J. A. The Outline of Science. Putnam's. $3.95.

Verzar, Fritz, and McDougall, E. J. Absorption from the Intestine. (1936) Longmans, Green. $9.00.

Walford, L. A. Marine Game Fishes of the Pacific Coast from Alaska to the Equator. (1937) California. $5.00.

Walton, E. P. and Foss, P. E. Social Biology. (May 1936) Blakiston's. $1.65.

Werner, A. A. Endocrinology. (1937) Lea & Febiger. $8.50.

In Preparation

Craig and Faust. Clinical Parasitology. Lea & Febiger.

Dobzhansky, Th. Genetics and the Origin of Species. Columbia.

Steel. Biological and Clinical Chemistry. Lea & Febiger.

Watson, E. L. G. Mysteries of Natural History. Stokes. $1.75.

White, G. Textbook of General Biology. rev. ed. Mosby.

THE CHORAL CLUB CONCERT

The Woods Hole Choral Club gave its eleventh annual concert at the Community Hall last Monday evening before a large and enthusiastic audience. Under the direction of Ivan T. Gorokhoff, who has been conductor of the Club since its inception, it presented a varied program of eleven selections, both light and serious. Mr. Millard W. Bosworth sang solos in two of the numbers.

The first part of the program consisted of music in a serious vein. It opened with a selection from one of Gluck's operas, "From the Realm of Souls Departed." This was followed by "Cantate Domino," an example of seventeenth century Latin music. The last two numbers were selections from the Russian liturgy.

The second part was composed of various types of music. It opened with a sixteenth century Italian tune, "One Smiling Summer Morning." A series of English and Scotch folk songs followed, in one of which, "Ca' the Yowes," Millard W. Bosworth was the soloist. The program ended with the Russian song, "The Gypsy," by Zolotarieff.

The president of the Choral Club is Dr. Eliot R. Clark, professor of anatomy at the University of Pennsylvania and a research worker at the Marine Biological Laboratory here. The secretary-treasurer is Dr. Charles Packard, assistant professor of zoology at Columbia University and clerk of the Marine Biological Laboratory Corporation. The accompanist was Galina Gorokhoff and the librarian was Boris Gorokhoff.

Sopranos taking part were Dorothy Birkett, Mrs. Jean Brachet, Lois Hutchings, Florence Hackett, Mrs. Rosa Jenkins, Anne Kidder, Mrs. W. Gardner Lynn, Mrs. Lawrence Saunders and Odette Secat; altos, Jane Bridgman, Mrs. Eliot R. Clark, Miss Peggy Clark, Alice O. Curwen, Katherine Hawley, Elizabeth Painter and Mrs. Warbasse; tenors, Richard G. Abell, Millard W. Bosworth, S. H. Liljestrand, W. Gardner Lynn, Philip H. Mitchel and Roland Walker; basses, W. W. Ballard, Floyd E. Chidester, Eliot R. Clark, B. I. Gorokhoff, Edwin Linton, A. J. Marshall, Charles Packard and Arthur Truslow.

The program: Part one, "From the Realm of Souls Departed," Christoph Gluck; "Cantate Domino," Hans Leo Hassler: "Cherubim Song," G. Musitcheskoo; "Hear My Prayer," A. Arkhangelsky; solo by M. W. Bosworth.

Part two, "One Smiling Summer Morning," Phillipe Verdelot; "Matthew, Mark, Luke and John," English Folk Song; "Peggy Ramsay," English Folk Song; "Ca' the Yowes," Scotch Folk Song; solo, M. W. Bosworth; "The Old Woman and the Pedlar," English Folk Song; "The Brook," A. Arkhangelsky; "The Gypsy," W. Zolotarieff.

DATE OF LEAVING FOR INVESTIGATORS

Alley, Armine res. asst. genet. McGill. OM 4. Aug. 9.
Andersch, Marie A. July 30.
Andrew, W. Aug. 4.
Armstrong, P. B. Aug. 21.
Bailey, P. L., Jr. Aug. 19.
Ballentine, R. July 27.
Bauer, K. F. July 26.
Beadle, G. W. Aug. 10.
Benoit, J. prof. agrégé d'hist. Strasburg Med. (France). L 30. July 26.
Bogdanovitch, S. B. Aug. 20.
Brisbin, G. W. T. Aug. 8.
Brown, D. E. S. asst. prof. New York Med. Br 214. July 6.
Claff, C. L. Aug. 3.
Commoner, B. Aug. 21.
Copeland, D. E. Aug. 10.
Culbreth, Sarah E. Aug. 11.
Dethier, V. G. Aug. 4.
Dorris, Frances. July 30.
Fisher, K. C. Aug. 17.
Goodrich, H. B. Aug. 11.
Henshaw, P. S. Aug. 1.
Hess, W. N. Aug. 19.
Hibbard, Hope Aug. 17.
Hiestand, W. A. July 28.
Hodge, C. Aug. 3.
Horvath, S. M. Aug. 12.
Hughes, Elizabeth Drumtra Aug. 10.
Hughes, R. D. Aug. 10.
Hunninen, A. V. Aug. 11.
Kreezer, G. July 17.
Kritzler, H. Bard OM 25. June 29.
Law, L. W. Aug. 2.
Miller, Faith S. July 24.
Mundt, G. H., Jr. Aug. 9.
Netting, M. G. Aug. 18.
Olson, M. Aug. 21.
Patrick, Ruth Aug. 3.
Pollister, A. W. July 29.
Ricci, Nelda I. July 30.
Richards, O. W. Aug. 19.
Riehl, Doris Aug. 7.
Ritchie, L. S. Aug. 3.
Robeson, J. M. July 31.
Russell, Alice M. July 30.
Salomon, K. Aug. 8.
Sawin, H. J. Aug. 7.
Scharrer, Berta Aug. 9.
Scharrer, E. Aug. 9.
Schotté, O. E. July 27.
Scott, A. C. Aug. 8.
Shannon, J. A. July 21.
Shapiro, H. res. asst. phys. Princeton. Br 115. June 18.
Shaw, I. Aug. 7.
Snider, R. S. Aug. 9.
Solandt, D. Y. July 26.
Solberg, A. N. Aug. 14.
Steinbach, H. B. Aug. 21.
Stoudt, H. N. Aug. 11.
Thornton, C. S. Aug. 20.
Turner, Abby H. Aug. 10.
Worley, Elizabeth Kinney July 19.
Worley, L. G. July 19.
Young, Dixie July 30.
Yntema, C. L. Aug. 13.
Zwilling, E. July 6.

Miss Rebecca Davis, who has spent a fortnight in Woods Hole for the last several summers (she is a cousin of Dr. Hannah Croasdale) is spending the summer visiting different galleries in Europe.

THE SUBMARINE CANYONS OF THE CONTINENTAL SHELF

(Continued from page 212)

Grand Canyon region shows many excellent examples of this kind.

When all the evidence which we have at present is weighed the question still remains an open one. There is no really satisfactory evidence to explain the origin of these extraordinary features. All the theories and explanations that have been put forward are open to serious objections. It would appear well-nigh impossible to raise the continental margins to the amount which is required and to do it uniformly over the world. On the other hand, submarine currents do not appear adequate either. Except for a better knowledge of the configuration of these topographic features and for the dating of their time of formation, they remain as much of a mystery as they were when they were first charted.

(This article is based on an evening lecture given at the Marine Biological Laboratory on August 20).

QUAKER CREED IN RELATION TO SCIENCE

Recently workers at the Marine Biological Laboratory received a statement of the philosophy of the Religious Society of Friends (the National Quaker organization) in the form of a letter addressed "To the Scientifically Minded." It bore the signatures of Dr. Jesse H. Holmes, Professor of Philosophy, Swarthmore College; Dr. Roscoe Pound, Deanof Harvard Law School; J. Russell Smith, Professor of Economic Geography, Columbia University; Thomas A. Jenkins, Professor of the History of the French Language, University of Chicago; and Albert T. Mills, Professor of History and Political Science, James Milliken University.

For a large number of people of Christendom, especially for those trained in scientific thinking, the great organized Christian churches are failing to supply the needed religious element. The trend of our time is scientific. It is impossible for a religion which ignores or opposes this tendency to serve the purposes of all who receive modern education.

Most of the churches through their official bodies insist upon the Apostles or the Nicene Creed, the inerrancy of the Bible, the virgin birth of Jesus, and the verity of the miracle stories of the old and new Testament, as essentials of belief. This letter is not addressed to those who are satisfied with such a creed; it is rather for any who have not found religious satisfaction.

This letter calls your attention to the Religious Society of Friends, commonly called Quakers. This society makes no claim to be a church in the sense of assuming authority to settle questions of doctrine or of historic fact. We are a **society of friends** whose members owe each other friendliness, and claim no authority one over another. We have no formal creed, and such unity as we have—and we have a great deal—is due to the fact that reasonable minds working on the same materials are likely to arrive at similar conclusions. However, we demand no unity of opinion and we find both interest and stimulus in our many differences.

Most Friends agree that the Sermon on the Mount presents the highest ideal for a way of life; this we accept not only on authority from without but mainly as conviction from within. We thus unite on a common purpose; a human society organized on a basis of good will and friendliness. There are differences among us as to details and methods, but not as to this desired end. Our objective determines for us the meaning of RIGHT and WRONG. RIGHT is that which serves the common purpose, WRONG is that which hinders or thwarts it. It is the standard by which we undertake to test the organization of society, international policies, and indeed all human conduct and institutions. Our opposition to war is based on the conviction that war hinders the development of the world family; yet we do not exclude from membership those who do not have that conviction. Many of us feel that our industrial system is in need of changes, but we have not arrived at unity as to what should be done about it.

We have deferred until this point the use of the word GOD—a word of diverse and uncertain meaning. To us GOD means a unifying influence which makes men long for a brotherly world; which tends to bind men together in unity. Our religion is built on such experience as the chief imperative of life. We have never been very particular about names; we have called this element of life the Reed, the Inner Light, the In-speaking Voice, the Christ Within, the Word. We are willing to have still other names: "The power not ourselves that makes for righteousness", The Hidden Dynamo, The Superself, The World-father, all seem to be proper symbolisms. Of course we do not claim to know if God is a person as we are persons. As we look ourselves over it doesn't seem altogether probable that the power which draws humanity together into the spirit of brotherhood is just a greater person than ourselves. But "It is not a question of personality or something less, but of personality or something greater."

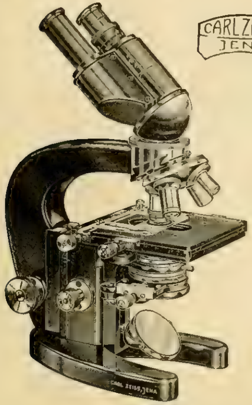
Whatever God may be and whatever life may mean, we are not insured against loss, suffering, and death. But there is an element of life greater than our normal everyday selves which enables us to rise abov loss and suffering and to face life and death without fear and with manly hearts.

The Religious Society of Friends is a group of people of good-will, working together for mutual support in making the God-element of life the commanding element. We never altogether succeed in doing this, but th effort is an essential part of our religion. It is only by squarely facing what is that man may hope to accomplish what **may be**: wherefore religion as we understand it has nothing to fear from science. Indeed we welcome every extension of mental horizon, every new discovery as to the nature of the world we live in.

We believe there are many who would find a richer life in membership with us, and we know that we need the strength of larger numbers. We need too the fellowship of men and women of intelligence and courage.

We invite correspondence with any of the signers of this letter at Friends' Advancement Committee, 1515 Cherry Street, Philadelphia, Pa.

The Collecting Net would welcome letters discussing the Quaker creed and its relations to science.—*Editor.*



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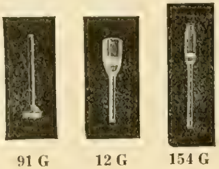

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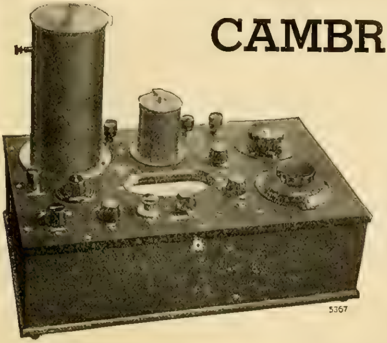

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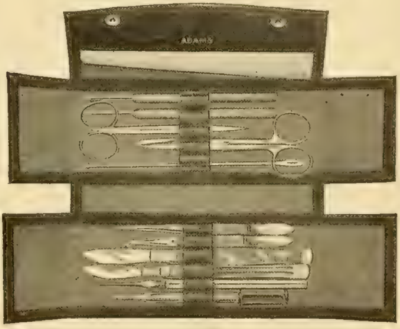

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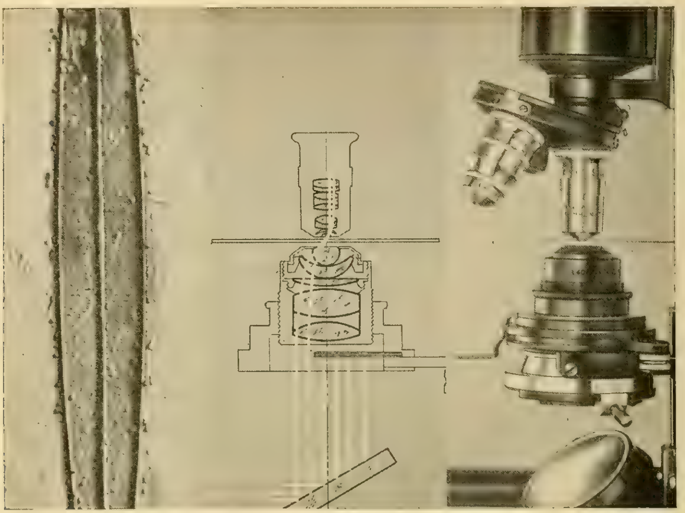

LEFT: Amphipleura Pellucida at 3000X was made with a Spencer 3mm. N. A. 1. 40 with a 20X compensating eyepiece. The illumination was oblique and an H (blue) filter was used. CENTER: The Path of Light. RIGHT: Spencer Balanced optical system with oblique light feature and centerable condenser.

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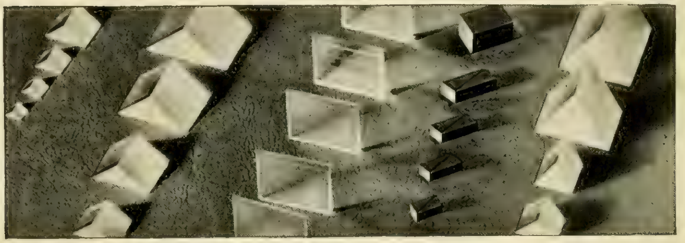

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